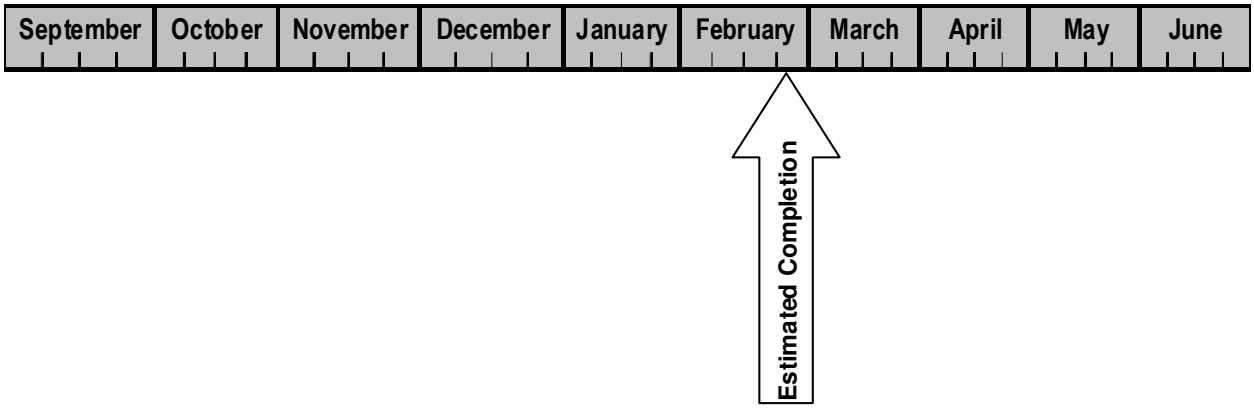
FRACTIONS AND DECIMALS

Suggested Time: approx 3½-4 weeks



Unit Overview

Big Idea

In everyday life, we often have measures that are less than one. In Grade Four, the focus is on students initially developing a firm understanding of these numbers.

At first, students will learn that fractions are one way to represent numbers less than 1. Students need to understand that a fraction represents one idea although it uses 2 numbers. The important part is the **relationship between** these two numbers. Teachers should provide situations in which students should compare fractions using concrete representations such as:

- Area models (part of a whole area)
- Length models (part of a length measurement)
- Set models (part of a set like objects)

"The ability to tell which of two fractions is greater is another aspect of number sense with fraction. That ability is built around concepts of fractions, not on an algorithmic skill or symbolic trick." (Walle and Lovin, 2006)

In the second part of this unit, students will be introduced to another way to represent numbers less than one - through decimals. An introduction to decimals requires familiarity with the concept of fractional tenths (lesson 7). Some students will be comfortable with the concept of tenths and will be ready to move into a study of decimal hundredths fairly quickly (lesson 8). Students will learn that decimals allow for calculations that are consistent with whole number calculations.

Process Standards Key

[C] Communication
[CN] Connections
[ME] Mental Mathematics and Estimation
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

Strand: Number

Specific Outcome

It is expected that students will:

4N8 Demonstrate an understanding of fractions less than or equal to one by using concrete, pictorial and symbolic representations to:

- **name and record fractions for the parts of a whole or a set**
- **compare and order fractions**
- **model and explain that for different wholes, two identical fractions may not represent the same quantity**
- **provide examples of where fractions are used**

[C, CN, PS, R, V]

Achievement Indicators:

4N8.4 Name and record the shaded and non-shaded parts of a given whole.

4N8.6 Represent a given fraction pictorially by shading parts of a given whole.

Suggestions for Teaching and Learning

The first goal in the development of fractions should be to help children construct the idea of *fractional parts of the whole*- the parts that result when the whole or unit has been partitioned into *equal-sized portions* or *fair-shares*. Children's familiarity with sharing amongst friends and separating a quantity into two or more equal parts is a real life connection to draw upon when beginning the concept development of fractions.

Even though a fraction has two numbers, it is one idea – the relationship between the two numbers. This can sometimes be confusing for students. The ***denominator*** tells how many parts the whole is divided into and the ***numerator*** tells how many there are of those equal parts.

The first fraction that students meet is usually $\frac{1}{2}$**.** Students will be familiar with the concept of $\frac{1}{2}$ as they frequently share things into two equal groups. Later students will use $\frac{1}{2}$ as a benchmark when comparing fractions.

To strengthen their fraction number sense, it is also recommended that the size of the whole be changed regularly. In Grade Four, the focus is on students initially developing a firm understanding of fractions less than one.

Students should be encouraged to develop visual images for fractions and be able to tell about how much a particular fraction represents. Representing a given fraction pictorially or by shading parts of a given whole, will help conceptualize this understanding. Provide opportunities for students to name a fraction from a given picture, such as:

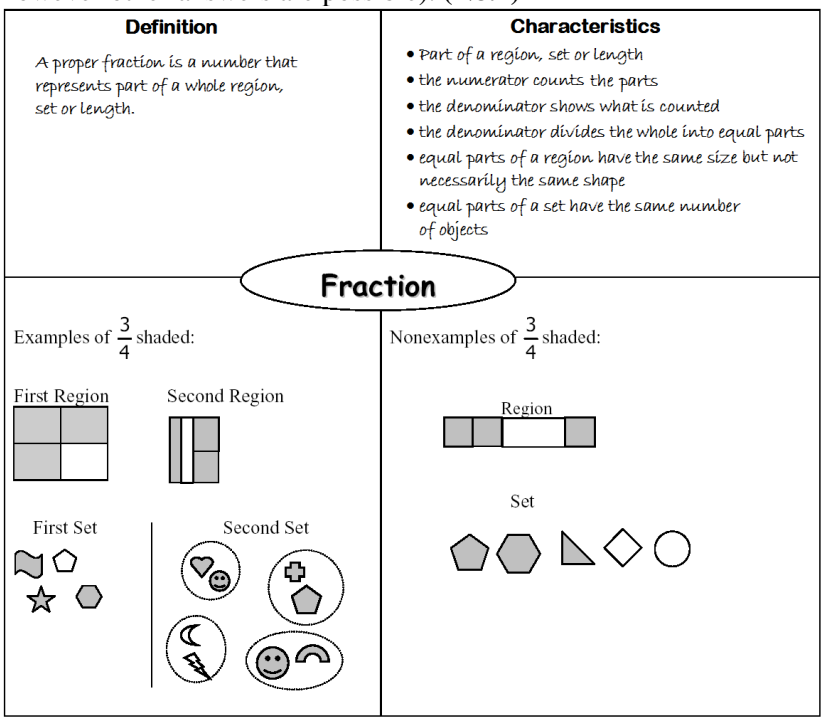
Colour pictures to show a fraction.
E.g. $\frac{2}{8}$ is green, $\frac{1}{8}$ is blue, and $\frac{5}{8}$ is red. Possible answer:

G	B	R	R
G	R	R	R

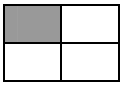
General Outcome: Develop number sense

Suggested Assessment Strategies

Performance
Have students summarize their understanding of fractions of a whole by completing a Frayer Model (Sample answers included below, however other answers are possible). **(N8.4)**



Performance
Given the following diagram:



(a) write a fraction representing the shaded part of the diagram
(b) write a fraction representing the unshaded part of the diagram **(N8.4)**

Student-Teacher Dialogue
Show a strip of 9 squares. Ask students to indicate $\frac{3}{9}$ of the strip and explain how they know. **(N8.4)**

Resources/Notes

Math Focus 4
Chapter Opener
TR. p 9

Getting Started
TR. pp.10-11

Lesson 1
Fractions of a Whole
N8 (8.4/8.6/8.13/ 8.14)
TR pp. 12 – 15
SB pp. 208 - 211

Additional reading:
Teaching Student-Centered Mathematics, Van de Walle and Lovin, 2006 p. 252)

Teaching Children Mathematics, NCTM

Strand: Number

Specific Outcome

It is expected that students will:
4N8 Continued

Achievement Indicators:

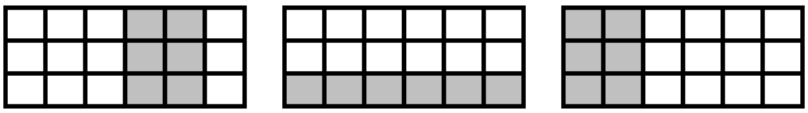
4N8.4 Name and record the shaded and non-shaded parts of a given whole.

4N8.6 Represent a given fraction pictorially by shading parts of a given whole.

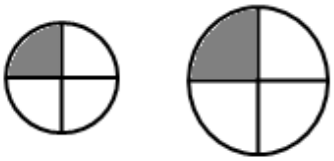
4N8.13 Provide examples of when two identical fractions may not represent the same quantity; e.g., half of a large apple is not equivalent to half of a small apple, half of ten blueberries is not equivalent to half of sixteen blueberries.

Suggestions for Teaching and Learning

Invite students to show the same fractional part of a whole in as many ways as they can.
E.g. The shaded part of the rectangle in these grids below shows one-third



"A key idea about fractions that students must come to understand is that a fraction does not say anything about the size of the whole or the size of the parts. A fraction tells us only about the relationship between the part and the whole. " (Van De Walle, 2006, p.267)
Consider this example:
Both Alex and Jennifer attend a pizza party. They decide that they both want $\frac{1}{4}$ of a pizza. They go to different areas to pick up their pizza. Alex takes $\frac{1}{4}$ of a pepperoni pizza, and Jennifer takes $\frac{1}{4}$ of a veggie pizza. When they meet back at their table, they realize that they do not have the same amount of pizza, but that Jennifer's is larger. They come to the realization that Jennifer's slice came from a larger pizza, and that they did not check the size of the wholes before selecting their choice. Van de Walle (2006, p 267) refers to this as the "pizza fallacy" in that whenever two or more fractions are discussed in the same context, the correct assumption (the one that Jennifer and Mark made) is that the fractions are all parts of the same size whole.



It is important for students to be able to explain why two identical fractions do not represent the same amount (when the wholes are different sizes). By providing everyday contexts in which the whole region varies in size, you stimulate the students' thinking to generalize that when comparing fractions, **the whole must be the same size for each fraction**.

Ask: Are halves always the same? Discuss student responses and demonstrate by cutting different kinds of fruit in half. For example, show students an orange and a watermelon and cut them in half. Discuss that the halves are different sizes even though they both represent the fraction $\frac{1}{2}$. This can also be demonstrated by using different sized glasses of water.

General Outcome: Develop number sense

Suggested Assessment Strategies

Journal
Sam ate $\frac{3}{4}$ of his pizza and Sara ate $\frac{3}{4}$ of her pizza. Sam said that he ate more pizza than Sara. Use pictures and words to explain how Sam could be correct. **(N8.13/8.14)**

Resources/Notes

Math Focus 4
Chapter Opener
TR. p 9

Getting Started
TR. pp.10-11

Lesson 1 (Cont'd)
Fractions of a Whole
N8 (8.4/8.6/8.13/ 8.14)
TR pp. 12 – 15
SB pp. 208 - 211

Additional reading:
Teaching Student-Centered Mathematics, Van de Walle and Lovin, 2006 p. 252)

Teaching Children Mathematics, NCTM

Strand: Number

Specific Outcome

It is expected that students will:

4N8 Continued

4N8.3 Name and record the shaded and non-shaded parts of a given set.

4N8.1Represent a given fraction, using concrete materials.

4N8.2 Identify a fraction from its given concrete representation.

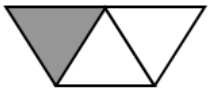
Suggestions for Teaching and Learning

In previous grades, students have worked only with *wholes* or *regions* and have had little experience working with *parts of sets*. The *part of a set* model is new to Grade Four, and therefore opportunities should be provided to allow this concept to be developed carefully.

An important point relating to *fractions of a set* is that the equal parts into which the whole is divided are equal but do not have to be identical. Students may be easily confused by sets that contain different items or are different shapes. For example:

What fraction of the set are female?
What fraction of the set are children?
What fraction of the set are wearing glasses?

Concrete materials must be used to develop fractional concepts adequately, therefore a variety of materials are effective. Pattern blocks are very useful models. Using pattern blocks as concrete representations for either fractions of a whole or fractions of a set can help students make connections between the two models. For example:



The triangle is $\frac{1}{3}$ of the trapezoid (fractions of a whole)

The triangle is $\frac{1}{4}$ of this set of 4 blocks (fractions of a set).

Other appropriate manipulatives when working with fractions include fraction circles, paper (for folding), fraction pieces, square tiles, egg cartons, Cuisenaire rods, counters, fraction bars or strips, money, number lines, geoboards, and grid/dot paper.

Show students a set of counters such as 8, 12, 16, or 20 and four paper plates. Share the set of counters into four equal groups, placing each group on a separate paper plate to show quarters. Point to one plate and ask students to identify the fraction. Repeat for a different number of plates.
Extension: Have students draw diagrams to match each concrete representation.

General Outcome: Develop number sense

Suggested Assessment Strategies

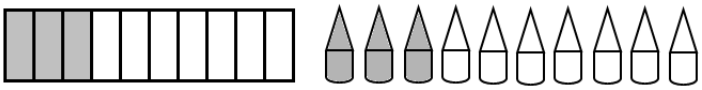
Using the pattern blocks identified in column 2, students create the whole (the hexagon) shown in column 1. Complete a table such as the one below, telling what fractional part of the whole each shape represents. (Possible answers: a trapezoid is $\frac{1}{2}$ of the hexagon, a rhombus is $\frac{1}{3}$ of the hexagon and a triangle is $\frac{1}{6}$ of the hexagon. **(N8.2)**

One Whole	Shape	Denominator	Numerator	Fraction Representing "Shape"
		2	1	$\frac{1}{2}$
		?	?	?

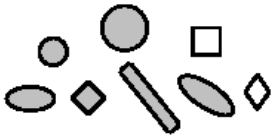
Student-Teacher Dialogue
Ask the students to "shake and spill" a number of colored counters and tell what fraction of the set is green, blue, yellow and red. **(N8.1)**

Journal
Have students create a design with at least two different types of pattern blocks and draw the design in their journal.
What fraction of the design is Red? Blue? Yellow? Green? **(N8.2)**

Ask students to explain why both pictures show $\frac{3}{10}$ **(N8.2)**



Student-Teacher Dialogue
In this set of shapes, how many are grey? **(N8.3)**



Resources/Notes

Math Focus 4

Lesson 2
Fractions of a Group
N8 (8.1/8.2/8.3/8.5/ 8.9/ 8.14)

TR. pp. 16 – 20
SB pp. 212 - 214

Teachers should supplement with additional practice as needed.

Strand: Number

Specific Outcome	Suggestions for Teaching and Learning
It is expected that students will: **4N8 (Continued)**	
4N8.9 Order a given set of fractions that have the same denominator, and explain the ordering.	**N8.9** An important fraction principle for students to understand, when comparing fractions, is that they can only be compared if the whole is known in each situation. When fractions have the same denominator, the one with the larger numerator is greater. E.g. $\frac{2}{3}$ is greater then $\frac{1}{3}$ because both fractions are thirds and you have more thirds in two-thirds than in one-third. Choose seven students and provide them each with a yarn necklace displaying a fraction, all having the same denominator. Instruct students to wear their necklaces so that the fractions are visible. Choose two other classmates to order the students from least to greatest. Invite discussions as to how they conducted the ordering. Repeat, using different fractions, ordering them from greatest to least. Ask three students to build the following towers using only red and yellow multi-link cubes: Tower #1- represents $\frac{2}{10}$ yellow cubes Tower #2- represents $\frac{5}{10}$ yellow cubes Tower #3 - represents $\frac{8}{10}$ yellow cubes First using the fractions $\frac{2}{10}, \frac{5}{10}, \frac{8}{10}$, ask students to secretly order the fractions from greatest to least and record their answer. Next, stand the towers side by side to check the ordering. This may be repeated with more fraction towers and ordering from least to greatest.
4N8.14 Provide, from everyday contexts, an example of a fraction that represents part of a set and an example of a fraction that represents part of a whole.	To help develop understanding of fractions, include everyday contexts for fractions, then use concrete representations and connect them to pictorial and symbolic representations. E.g. Ask a group of 10 students to come to the front of the class. Ask: What fraction of the students are girls? Boys? Wear glasses? Have dark hair? Have students present their findings using pictures (shading parts of a set), and symbols (write fractions). Some other valuable contexts that can be used to teach fractions of a set include: - sharing food (sharing a dozen cookies by giving everyone $\frac{1}{4}$ of a dozen) - teams ($\frac{9}{10}$ of the volleyball team played last year) - music (4 quarter notes in each measure of a $\frac{4}{4}$ time signature)

General Outcome: Develop number sense

Suggested Assessment Strategies

Student-teacher Dialogue
Have various concrete materials available. Present pairs of fractions with like denominators to students. Have students:

- decide which fraction is greater
- explain why they think this is so
- test their choice using any model they wish to use **(N8.9)**

Presentation
Randomly divide the class into 3 different sized groups, and ask each group to write a fraction that represents the number of boys and girls in their group. Then ask them to present their fractions to the class and tell which fraction is greater, the fraction representing the boys, or the one representing the girls. (e.g. "Our group has 3/8 boys and 5/8 girls. There are more girls than boys").
The groups should then be able to explain their reasoning based on the concept that when the denominators are the same, the numerator determines the larger number. (**N8.9)**

Performance
Sharing Brownies **(N8.5)** - This activity will allow students to use higher level thinking skills as they construct their knowledge about fractions of a set. Provide students with several paper squares to represent fudge brownies. Have students experiment by cutting the brownies to solve the following problems:
- How can 4 people share 3 brownies?
- How can 3 people share 2 brownies?
- How can 12 people share 6 brownies?
- How can 6 people share 4 brownies?

(Differentiate task, using numbers according to individual student ability). Write responses on a recording sheet such as the following:

Draw a picture of the divided brownies. _____ brownies shared by _____ people. One person's share is _____ (write the fraction).

Student-Teacher Dialogue **(N8.9**)
What possible denominators could be used in the statement below?
(Several answers possible) $\frac{1}{\mathbf{?}} < \frac{1}{\mathbf{?}}$

Resources/Notes

Math Focus 4

Lesson 2 (Cont'd)
Fractions of a Group
N8 (8.1/8.2/8.3/8.5/ 8.9/ 8.14)

TR. pp. 16 – 20
SB pp. 212 - 214

Strand: Number

Specific Outcome	Suggestions for Teaching and Learning
It is expected that students will: **4N8 Continued**	
4N8.14 Provide, from everyday contexts, an example of a fraction that represents part of a set and an example of a fraction that represents part of a whole.	Students should be encouraged to think about how they use fractions in their everyday lives. Have students look for fractions in magazines and newspapers and discuss how they display important information about real life. Some valuable contexts that can be used to make connections with fractions of a whole include: - sharing food (dividing a pizza into 8 equal pieces) - measuring time ($\frac{3}{4}$ of an hour) - measuring food for recipes ($\frac{1}{2}$ cup of butter) - money ($\frac{1}{4}$ of a dollar) - art ($\frac{3}{4}$ of the design is red) - music (eighth, quarter and half notes)
4N8.5 Represent a given fraction pictorially by shading parts of a given set.	Write the fractions $\frac{8}{12}$ and $\frac{4}{12}$ on the board and brainstorm real-life situations involving parts of a set that these fractions could represent. Using student generated stories, have them represent the fractions pictorially by shading parts of the set. E.g. a carton of eggs fell off the shelf in a grocery store, and 8 of them were broken. What fraction of eggs were not broken? Repeat using other fractions. This activity could be reversed whereby teachers could draw the shaded and nonshaded parts of the set, ask students to brainstorm real-life situations, and then write the fractions represented by their models. Ask students to make illustrations to show the following: a. $\frac{2}{3}$ of the bananas are ripe b. $\frac{4}{5}$ of the floor tiles are striped c. $\frac{1}{3}$ of the balls are basketballs d. $\frac{4}{9}$ of the fruit are oranges (**N8.5)**

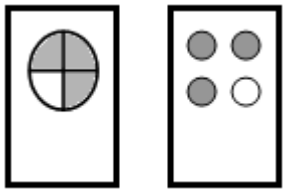
General Outcome: Develop number sense

Suggested Assessment Strategies

Fraction Concentration

Create fraction cards sets containing fractions of a whole and corresponding fractions of a set. Shuffle the cards, and place them face down on a desk. The first player turns over any two cards and checks to see if the cards match. If a match is made, the player must tell his/her opponent what fraction each card represents. If both agree that the answer is correct, the player keeps the cards and takes another turn. Players continue to take turns until all the possible matches have been made. The player with the most matches wins the game.

Sample play:



Player says: "My match represents the fraction $\frac{3}{4}$ (three-fourths)"

(N8.5/8.6)

Performance

Fraction Sundaes-Provide a variety of colored construction paper and instruct students to make scoops of ice cream to represent various flavors (e.g. brown for chocolate, green for pistachio, etc.). (You may provide a stencil). On a 12"x 17" paper students should design a dish to hold their sundae. Create the sundae by gluing the scoops on the dish. On the side of the paper or on the sundae dish, students use fractions to represent each flavor of ice cream in their sundaes. **(N8.5)**

Resources/Notes

Math Focus 4

Lesson 2 (Cont'd)
Fractions of a Group
N8 (8.1/8.2/8.3/8.5/ 8.9/ 8.14)

TR. pp. 16–20
SB pp. 212 - 214

Strand: Number

Specific Outcome

It is expected that students will:
4N8 Continued

4N8.7 Explain how denominators can be used to compare two given unit fractions.

Suggestions for Teaching and Learning

Once students have developed a good understanding of naming and recording both fractions of a whole and of a set, they should be able to communicate how the fractions they have modeled are alike and different. They should be encouraged to communicate their findings pictorially, symbolically, and with words.

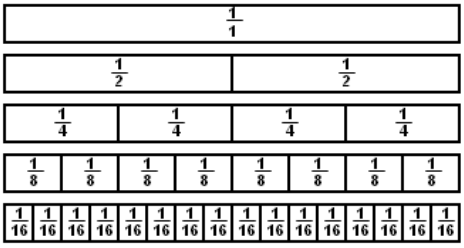
Ask students to draw as many pictures as they can of $\frac{4}{6}$, then share their pictures with a partner and discuss the following:

1. How are your pictures the same?
   sample responses: -they both show 4 parts out of 6
   -they both show parts of a whole
   -they both show parts of a set
2. How do your pictures differ?
   sample response: -one shows parts of a whole, and the other shows parts of a set

A unit fraction has a numerator 1, as in $\frac{1}{5}$. Therefore with a unit fraction, the larger the denominator the smaller the fraction part.

Ask students: Three girls took part in a skip-a-thon. Sydney, exercised $\frac{1}{5}$ of an hour, Paula exercised $\frac{1}{3}$ of an hour, and Beth exercised for $\frac{1}{2}$ of an hour. Who won the skip-a-thon? (Beth)

Models such a *Fraction Strip Kit*, described below, will help students compare fractions in symbolic form:
Have students make fraction strips by cutting strips of varied colored construction paper and folding them to represent fractions as parts of a whole. Ask students to take a strip of a particular color, and label it 1, or $\frac{1}{1}$. This strip represents the whole. Then take a second strip of the same length, fold it in half, and label each section $\frac{1}{2}$. Next, choose a third strip and have the students fold it into four equal pieces, and label each section $\frac{1}{4}$. Continue this process with eighths and sixteenths. Discuss the meaning of each fraction as students fold the strips. Having students cut and label the pieces helps them relate the fraction paper and compare the sizes of fractional parts. For example, the students can see that: $\frac{1}{8}$ is larger than $\frac{1}{16}$ and that two $\frac{1}{4}$ pieces are equal to a $\frac{1}{2}$ piece. (Tip: Have students label the back of the pieces with their initials)



General Outcome: Develop number sense

Suggested Assessment Strategies

Performance
Fraction Game - "Cover Up"- This game requires using the cut up fraction pieces from the fraction kit made on the previous page, and involves two or more players. Each player starts with a whole strip from the fraction kit. The goal is to be the first to cover the whole strip completely with the other pieces of the fraction kit. No overlapping pieces are allowed.

Rules for play:
1. Children take turns rolling a cube labeled with fractions:
($\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{8}$, $\frac{1}{16}$, $\frac{1}{16}$)

2. The fraction face up on the cube tells what size piece to place the whole strip.

3. When the games nears the end and a student needs only a small piece, such as $\frac{1}{8}$ or $\frac{1}{16}$, rolling $\frac{1}{2}$ or $\frac{1}{4}$ won't do. The student must roll exactly what is needed.(Burns, About Teaching Mathematics, 2000 p. 227)

(N8.1/8.7)

Student-Teacher Dialogue

Pose the following question: What would you rather have, $\frac{1}{4}$ of a pizza, or $\frac{1}{3}$ of a pizza? Explain the reason for your choice using pictures and words. **(N8.7)**

Journal
When can $\frac{1}{4}$ give you a bigger piece of something than $\frac{1}{2}$? Draw diagrams to help explain your answer. **(N8.7)**

Resources/Notes

Math Focus 4

Lesson 3
Sorting Fractions
N8 (8.1/8.5/8.6)

TR pp. 21 – 23
SB p. 215

Lesson 4
Comparing and Ordering Fractions
N8 (8.1/8.2/8.6/8.7/8.8)

TR pp. 24 – 28
SB p. 216 - 218

Lessons 3 and 4 can be addressed together. Lesson 3 is brief but helps to set the stage for lesson 4.

Strand: Number

Specific Outcome

It is expected that students will:
4N8 Continued

4N8.8 Order a given set of fractions that have the same numerator, and explain the ordering.

Suggestions for Teaching and Learning

Children have a strong mindset about numbers that may cause them difficulties with the relative size of fractions. In their experience, larger numbers mean "more". A common misconception is for students to transfer previously learned whole-number concepts to fractions, thinking seven is more than four, so sevenths should be larger than fourths. The inverse relationship between number of parts and size of parts is better understood by students when they explore and discover this on their own rather than be told.

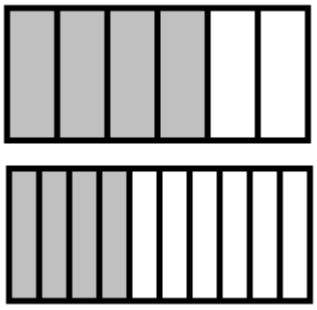
Provide students with 4 strips of ribbon of equal length. Instruct them to fold and cut the ribbons to represent the fractions below, and then order them from least to greatest. Keep one strip "whole" for comparison. Ask students to explain their thinking.

(1) $\frac{4}{6}$

(2) $\frac{4}{8}$

(3) $\frac{4}{10}$

Lead students into a discussion on the concept that fractions with different denominators have the whole divided into the different sized parts. If you have the same number of parts (like numerators) in two situations but the parts in one fraction are smaller than the parts in another fraction, than the fraction with the smaller denominator (showing larger parts) is greater.
E.g. Sixths are greater than tenths, therefore four-sixths is greater than four tenths.



Review with students the concept discussed in earlier lessons that the whole must be the same when comparing fractions.

General Outcome: Develop number sense

Suggested Assessment Strategies

Performance
Pose the following problem:
Matthew, Chris and Peter recorded their batting scores at the batting cage:

Matthew- $\frac{2}{8}$

Chris - $\frac{2}{6}$

Peter- $\frac{2}{5}$

Matthew put the scores in order from greatest to least, and said that his batting average was the highest, Chris' second, and Peter's third. Was Matthew's ordering correct? Explain your thinking. **(N8.8)**

Resources/Notes

Math Focus 4

Lesson 4
Comparing and Ordering Fractions
N8 (8.1/8.2/8.6/8.7/8.8)

TR pp. 24 – 28
SB p. 216 - 218

Curious Math
TR p. 29
SB p 219

Strand: Number

Specific Outcome

It is expected that students will:
4N8 (Continued)

4N8.10 Identify which of the benchmarks, 0 or 1, is closer to a given fraction.

Suggestions for Teaching and Learning

The most important reference points for fractions are 0, $\frac{1}{2}$ and 1, and are referred to as **benchmarks**. Comparing fractions to these three benchmarks can provide students with a lot of information. Understanding why a fraction is close to 0, $\frac{1}{2}$, or 1 is a good beginning for fraction number sense. It begins to focus on the relative size of fractions in an important, yet similar manner.

Invite 3 students to represent the 3 benchmarks by holding a skipping rope at the beginning, middle and end. Two students, each holding one end, represent endpoints, 0 and 1 and have a third student stands in the middle to represent $\frac{1}{2}$. Give several students fraction cards and ask them to stand in front of the person representing the benchmark closest to their fraction. Example: A student might say, "$\frac{2}{10}$ is closer to 0, so I'll stand in front of Amy who is holding the zero end of the rope."

Identifying which of the benchmarks 0, $\frac{1}{2}$, or 1 is closer to a given fraction can be done by using the following strategies:
(1) <u>with paper fraction strips</u>
Provide the students with fraction strips showing halves and other fractions, such as thirds, quarters, fifths and tenths. Using the fraction strips, have the students order two fractions by comparing each fraction to one-half, such as one-quarter and two-thirds or three-fifths and eight-tenths. Through discussion, have the students generalize that some fractions can be ordered by deciding if they are greater than or less than one-half.

(2) <u>by looking at the denominator and numerator</u>
Ask the students to explain how they would know if a fraction was greater than or less than one-half without using the paper fraction strips. Guide students to explore and conclude, on their own, that if the numerator is less than half the denominator, then the fraction is less than one-half. Similarly, if the numerator is greater than half the denominator, then the fraction is greater than one-half. If the numerator is half the denominator, then the fraction shows another name for one-half.

General Outcome: Develop number sense

Suggested Assessment Strategies

Performance
Prepare a lunch bag with several fraction cards inside. Divide the class into groups of three and assign each player a benchmark title of $0, \frac{1}{2}$, or 1. Have players draw a fraction card from the bag and decide which benchmark the fraction is closest to. The player with that benchmark name receives a point. Play continues until a player has reached a predetermined number of points. **(N8.10)**

Journal
A mother instructed her two children Gregory and Brandon, to eat all of the broccoli on their plates. Brandon ate 6 out of his 8 pieces of broccoli, and Gregory ate 5 out of his 10 pieces. Which child better followed the mother's instructions? Draw pictures to help explain your answer. **(N8.10)**

Michael wanted to run all the way home but only got $\frac{3}{8}$ of the way when he became tired and walked the rest of the way. Did he run more/less than half the way home or all the way home? Draw a number line to show your thinking. **(N8.10)**

For each situation, decide whether the best estimate is more or less than $\frac{1}{2}$.

1. When pitching, Dan struck out 6 out of 16 batters.
2. Lauryn couldn't finish 3 out of 10 math problems.
3. Nick fouled out 5 times in 9 basketball games.
4. Jane sold 4 out of 12 boxes of Girl Guide cookies.
5. Adrian won 9 out of 16 cup stacking games.

Create your own situation and trade with a partner to solve. **(N8.10)**

Performance
Look at these fractions: $\frac{3}{4}$ or $\frac{7}{8}$
Which fraction is closer to $\frac{1}{2}$?
Explain using words and pictures. **(N8.10)**

Resources/Notes

Math Focus 4

Lesson 5
Using Benchmarks to Order Fractions
N8 (8.10/8.11/8.12)
TR pp. 31 -34
SB p. 220 - 222

Math Game
Pot of Gold
TR pp. 24 – 28
SB pp. 216 - 218

Strand: Number

Specific Outcome

It is expected that students will:

4N8 Continued

4N8.11 Name fractions between two given benchmarks on a number line (horizontal and vertical).

4N8.12 Order a given set of fractions by placing them on a number line (horizontal and vertical) with given benchmarks.

Suggestions for Teaching and Learning

To place the fractions on a number line using benchmarks of 0, $\frac{1}{2}$ and 1, students must also make estimates of fraction size in addition to simply ordering the fractions.

Ask students to name fractions between two given benchmarks on a number line. For example, when asked to name a fraction between 0 and $\frac{1}{2}$, encourage students to think of as many possibilities as they can, using a set of fractions with like denominators, ($\frac{1}{5}, \frac{2}{5}, \frac{3}{5}, \frac{4}{5}$), or unlike denominators ($\frac{1}{3}, \frac{3}{10}, \frac{5}{12}$, etc.)

When ordering fractions, fractions strips can be placed against a number line to help mark the fractions. A good introduction to this concept is to provide students with fraction strips of fourths, eighths, twelfths, and sixteenths, and ask students to identify the fractions that are equal $\frac{1}{2}$. This benchmark is the most familiar with students as they frequently share things into two equal groups. Students can then extend their understanding by ordering other fractions by using words such as ‘closer to’, or ‘less than’ half. Consider using and overhead transparency cut into fraction strips resembling student sets. Using an overhead projector to order fractions will help confirm students’ individual responses to ordering of their own fraction strips.

General Outcome: Develop number sense

Suggested Assessment Strategies

Performance
Fractions Marching in Order - Have the students draw a number line indicating 0, $\frac{1}{2}$ and 1. Provide the students with five or six fractions and have them place them in order on the number line, explaining how they know where each fraction should be placed. Examples of fractions to place on the number line using the benchmarks might include:

$\frac{3}{4}, \frac{1}{5}, \frac{7}{8}, \frac{3}{6}, \frac{2}{5}, \frac{1}{3}$ **(N8.10/8.11/8.12)**

Performance
Play a game with the whole class in which students use tiles or pattern blocks to illustrate fractional amounts. Place fractions on a number line labeled 0, $\frac{1}{2}$ and 1. Place some in correct places and some in incorrect places (e.g., place $\frac{9}{10}$ between 0 and $\frac{1}{2}$). Have students illustrate the specified amount with their manipulatives. Then have them close their eyes and respond by showing thumbs up to indicate agreement with your placement or thumbs down to show disagreement. Students can then play this game in pairs taking turns placing fractions on the number line and responding.

(N8.10/8.11/8.12)

Resources/Notes

Math Focus 4

Lesson 5
Using Benchmarks to Order Fractions
N8 (8.10/8.11/8.12)
TR pp. 31 -34
SB pp. 220 - 222

Strand: Number

Specific Outcome

It is expected that students will:

4N8 Continued

4N8.2 Identify a fraction from its given concrete representation.

4N8.5 Represent a given fraction pictorially by shading parts of a given set.

4N8.6 Represent a given fraction pictorially by shading parts of a given whole.

4N8.14 Provide, from everyday contexts, an example of a fraction that represents part of a set and an example of a fraction that represents part of a whole.

Suggestions for Teaching and Learning

Below are three types of problems using fractions of a *whole* and *set* that can help children develop their understanding of fractional parts. Students can draw diagrams and pictures to help visualize their understanding.

1.Find the **Part**

(given the *whole* and the fraction):

Mr. Hann is building a patio and wants to partition one-fourth of it for a BBQ. If the whole patio looks like this:

How big is the space for the BBQ?

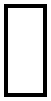
(given the *set* and the fraction)

Michael purchased a set of 40 golf balls and wants to take one-fourth of them to his golf tournament. How many did he take?

2.Find the **Whole**:

(given the *part* and the fraction)

Mr. Hann has finished one-third of his patio. It looks like this:



Draw a picture that might be the shape of the finished patio.

(given the *part of the set* and the fraction)

If 12 cookies make up $\frac{3}{4}$ of a batch of cookies, how many cookies are in the entire batch?

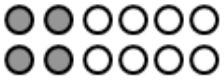
3. Find the **Fraction:**

(given the *whole* and the part)

Shawn ran in a cross- country race. What fraction of the race did he complete?

(given the *whole of the set* and the part)

Tyler bought a dozen eggs to make pancakes. If the recipe requires 4 eggs, what fraction of the carton will Tyler use?



General Outcome: Develop number sense

Suggested Assessment Strategies

Journal

Give an example of how drawing a diagram could help you solve a fraction problem. Use words, pictures and numbers to help you explain.

Pencil-Paper

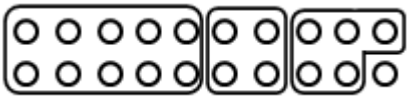
If adults get the daily-recommended amount of sleep - 8 hrs per night - what fraction of our day do we spend sleeping? Awake?
Draw a diagram to help explain your thinking.

Pencil-Paper

Jane gave $\frac{4}{12}$ of her hockey cards to her brother, and $\frac{3}{12}$ of the cards to her friend. What fraction of the cards did she keep for herself?

Paper-Pencil

Twenty students in the class were surveyed on their favourite sport. $\frac{1}{2}$ of the class preferred basketball, $\frac{4}{20}$ of the class preferred soccer, and $\frac{5}{20}$ preferred volleyball. Did all twenty students in the class vote? Draw a diagram to help explain your answer. Sample of student possible student response:



Resources/Notes

Math Focus 4

Lesson 6
Solving Problems by Drawing Diagrams
N8 (8.2/ 8.5/ 8.6/ 8.14)
TR pp. 37 - 40
SB pp. 224 - 226

Curious Math
Drawing With Fractions
N8 (8.4/ 8.6/ 8.14)
TR pp.41 - 42
SB pp. 227

Mid Chapter Review
Be Selective

Strand: Number

Specific Outcome

It is expected that students will:
4**N8 Continued**

4N8.3 Name and record the shaded and non-shaded parts of a given set.

Suggestions for Teaching and Learning

N8.3 was previously addressed with work related to fractions; however, it reappears here in the context of decimals. Students have had experience learning about fractions and have an understanding that can be transferred to incorporating the symbols to a new notation - decimal numbers. Most importantly, students will learn to make sense of decimal numerals which they will use later. They will also learn that decimals allow for calculations that are consistent with whole number calculations.

It is expected that students will:
4N9 Represent and describe decimals (tenths and hundredths), concretely, pictorially and symbolically. [C, CN, R, V]

According to Small (2009, p.62), students will learn important decimal principles, through the use of concrete materials, pictorial representations, and modeling. Using decimals extends the place value system to represent parts of a whole. The use of a decimal point must be taught as a symbol that separates the tenths from the ones, or in other words, the 'part from the whole'. Some principles are:

1. The base ten place value system is built on symmetry around the ones place and the decimal.
2. Decimals can represent parts of a whole, as well as mixed numbers.
3. Decimals can be interpreted and read in more than one way. Students should become familiar and comfortable renaming and reading decimals in several ways. E.g. 4.3 may be renamed 43 tenths.
4. Decimals can be renamed as other decimals or fractions. E.g. $\frac{60}{100}$ may be represented as 0.60, $\frac{6}{10}$, or 0.6.

We often have measures that are less than one. Previously in this unit students learned that fractions are one way to represent these numbers. Now students will be introduced to another way to represent numbers less than one - through decimals. An introduction to decimals requires familiarity with the concept of fractional tenths (lesson 7). Some students will be comfortable with the concept of tenths and will be ready to move into a study of decimal hundredths fairly quickly (lesson 8).

Focus on the need to continue the pattern in our base ten number system, so that the unit (or the whole) is divided into ten equal parts (or tenths) and another place value is included to the right of the ones place, separated by a dot (referred to as a **decimal**) to show that it is a fractional part. This shows the connection between fractions and decimals, as well as the connection between whole numbers and decimals; e.g. $\frac{2}{10}$ = 0.2. Explain that we often write 0.2 rather than the fractional notation. (Continued)

General Outcome: Develop number sense

Suggested Assessment Strategies

Resources/Notes

Math Focus 4

Lesson 7
Decimal Tenths
N8 (8.3)
N9 (9.1/ 9.2/ 9.6)
N10 (10.1/ 10.2/ 10.3/ / 10.10.4/ 10.5)
TR pp.46 – 49
SB pp. 230 - 232

These elaborations, while specifically referring to tenths in lesson 7, are also applicable to lesson 8 with extensions to hundredths.

It is important to foster understanding of decimals by ensuring that they can be read correctly. If cases arise in which there is a numeral in the ones place and well as numerals in the tenths and/or hundredth places, avoid using the term 'point'. It has no mathematical meaning to students. Rather, use the word "and" to represent the decimal when reading a number aloud. For example 3.4 should be read as '3 and 4 tenths' not '3 point 4' or '3 decimal 4'. Saying decimal numbers correctly will assist students in gaining an understanding of how decimals relate to fractions.

Strand: Number

Specific Outcome

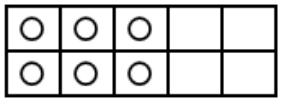
It is expected that students will:

4N9 Continued

Suggestions for Teaching and Learning

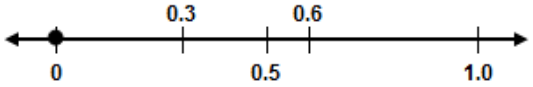
Throughout the study of decimals, there are different concrete materials that will aid students in the understanding of decimal concepts:

- Ten frames (tenths)



0.6 or "six tenths"

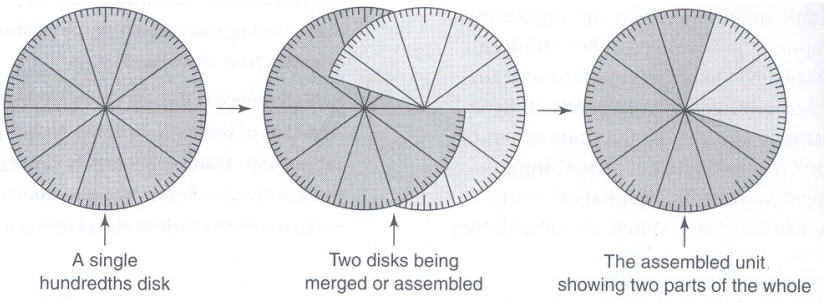
- Number lines (tenths and hundredths)



- Money (hundredths) - dollar as the whole, dimes as tenths, and pennies as hundredths

- Meter Stick (hundredths)

- Hundredths Disks (tenths and hundredths) – copy circular discs such as these shown below on two different colored card. Each disk is marked with 100 equal intervals around the edge and cut along one radius. The two discs are slipped together and can be used to represent a fraction or a decimal less than 100.



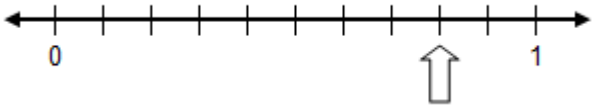
(Source: Van de Walle, Teaching Student Centered Mathematics Grades 3-5. Page 182)

(Continued)

General Outcome: Develop number sense

Suggested Assessment Strategies

Performance
This activity could be repeated frequently as a part of the daily routines. Supply each student with a small whiteboard and a dry erase marker (This can be also done with paper and marker). Display a large number line. Place a removable pointer such as a magnet, clothespin or Post-It arrow on one of the tenth divisions. Students write the decimal to represent the number indicated and hold up the answer. Repeat for other numbers. **(N9.1/10.4)**



Resources/Notes

Math Focus 4

Lesson 7 (Cont'd)
Decimal Tenths
N8 (8.3)
N9 (9.1/ 9.2/ 9.6)
N10 (10.1/ 10.2/ 10.3/ 10.4/ 10.5)
TR pp.46 – 49
SB pp. 230 - 232

Strand: Number

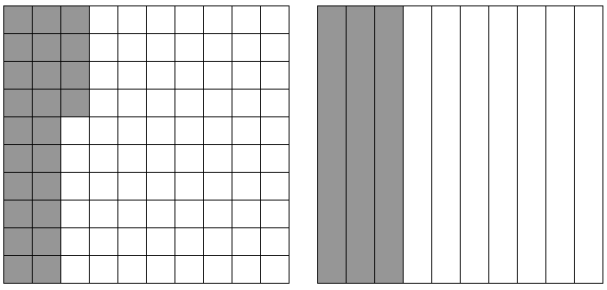
Specific Outcome

It is expected that students will:

4N9 Continued

Suggestions for Teaching and Learning

- Base Ten Materials and/ or Decimal Grids (10 x 10 Paper squares - hundredths and tenths)



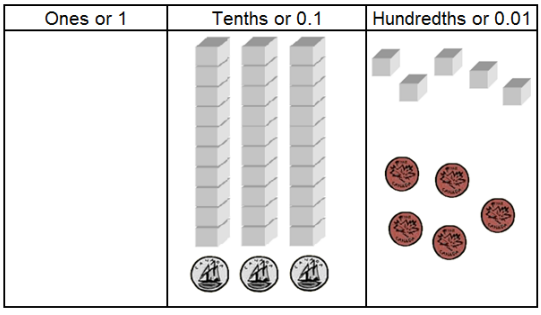
0.24 or "twenty-four hundredths"

0.3 or "three tenths"

Previously in the Numeration unit, students used base ten materials to represent whole numbers. Using the same materials, to now represent decimals, can be challenging for some students. When using whole numbers previously, the flat represented 100, the rod represented 10, and the small unit cube represented 1. Throughout **this** unit, the *flat* is 1, the *rod* is 0.1, and the small *unit cube* is 0.01. Ensure that students **do not** refer to the flat as '100' but as a '*whole'*. It would be helpful if the *flat* were related to everyday items such as a rectangular cake, *one whole*, then the rod could represent a slice that is *one tenth of the whole cake*. The small unit cube would represent a bite of the slice or *one hundredth of the whole cake*. **Refer to the N1 elaboration (beginning of Numeration unit) for review of appropriate use of terms relating to the Base Ten materials.** Note that the overhead base ten materials are very useful as a means of showing various base ten representations to the whole class for discussion.

Some students struggle with this model change, from whole numbers to decimals. As you discuss this different way of thinking about using Base Ten materials, in the teaching of decimals, you may have students work with paper copies of a hundredths grid. The cutting of the paper model may clarify students' understanding and better suit various learning styles.

- Place Value Mat (used with money and base ten blocks)



0.35 or "thirty-five hundredths"

General Outcome: Develop number sense

Suggested Assessment Strategies

Resources/Notes

Math Focus 4

Lesson 7
Decimal Tenths
N8 (8.3)
N9 (9.1/ 9.2/ 9.6)
N10 (10.1/ 10.2/ 10.3/ / 10.10.4/ 10.5)
TR pp.46 – 49
SB pp. 230 - 232

Strand: Number

Specific Outcome

It is expected that students will:
4N9 Continued

4N9.1 Write the decimal for a given concrete or pictorial representation of part of a set, part of a region or part of a unit of measure

4N9.2 Represent a given decimal, using concrete materials or a pictorial representation.

4N9.6 Provide examples of everyday contexts in which tenths and hundredths are used.

Suggestions for Teaching and Learning

Give students various shapes cut from Bristol board or drawn on large paper. When you prepare the shapes be sure to use the flats, rods and units to guide your drawings so that the materials actually fit inside the shapes. Have them cover the shape using base ten materials and then proceed to find the value of the shapes if a flat represented a whole, a rod represented tenths and a unit represented hundredths. Name the shapes with a letter for easy reference as students record the decimal numeral represented. Conversely, give the students a decimal number and have them use that amount of base ten materials to create a 2-D or 3-D object.

Children's Literature Link - Use children's literature to provide contexts for dealing with decimal tenths. For example, 10 for Dinner by Ellen Bogart (1989) is a funny counting book about a girl, Margo, who invites ten friends for dinner on her birthday. One guest stands out more than the others. He arrives early wearing his Halloween costume, asks for a peanut butter sandwich with olives and sauerkraut, makes a hat like the Loch Ness monster, sings a solo, wants to play "dirty-double no-hands blindfolded marbles," and brings the most interesting present. Use this story to provide a context when asking students to describe the subgroups of children.

Make a set of cards showing decimal tenths (for example 0.5 or 0.9) Have students choose a card and in their journals, illustrate the decimal with a picture or show the decimal using concrete materials (see previous pages for suggested materials).

Teaching decimals, through meaningful contexts such as those below, will strengthen student understanding:

- Fingers and toes
- Items that are packaged in tens, such as pencils, stickers, sticks of gum
- Food that can be shared among ten people, such as pizza or cake
- Metre stick: metre stick as whole, centimetres as hundredths
- Scores and times for various sporting events e.g. hundred meter dash was completed in 13.9 sec.
- Statistics of athletes (e.g. points per game, etc.)
  e.g. NBA's Chris Paul averages 11.8 assists per game
  or NHL's Sidney Crosby averages 1.5 points per game
- Gas prices on signs show price to the nearest tenth (89.9 cents per litre)

General Outcome: Develop number sense

Suggested Assessment Strategies

Presentation
Ask students where they would find decimal numbers in their daily lives. Working in groups, have students find as many decimal numbers as they can in newspapers. Next, have students tell classmates what the number is and the context in which the number is used (e.g. price of an item, average rainfall or temperature in an area, price of gas, etc.).
Students present their findings to the class.

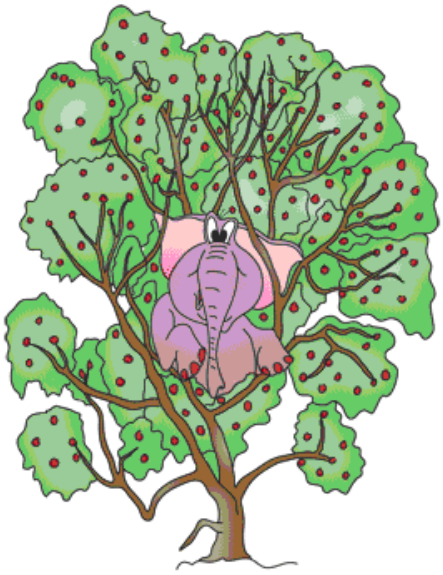
Performance
Using a number line from zero to one (a paper copy, a piece of string, ribbon or wool, or a string displayed at the front of the room), ask individual students to plot numbers such as the following: 0.5, ten tenths, seven tenths, etc.

Performance
Present the following poem - *Why the Elephant Painted Its Toenails Red* by Wayne Edwards as a lead-in to this task about decimal tenths:

I asked the little elephant,
"Why are your toenails red?"
"It's really very simple
Is what I think he said.

It seems the little elephant
Was playing hide-and-seek,
With all the other animals
In our back yard last week.

Elephants are kind of big,
It's hard to hide, you see.
So he painted all his toenails red
And hid up in our cherry tree.



Provide students with an illustration of two bare feet. Ask students to color or place red counters on toenails based on fractions that you present to them orally or in writing.

Resources/Notes

Math Focus 4

Lesson 7 (Cont'd)
Decimal Tenths
N8 (8.3)
N9 (9.1/ 9.2/ 9.6)
N10 (10.1/ 10.2/ 10.3/ / 10.10.4/ 10.5)
TR pp.46 – 49
SB pp. 230 - 232

Strand: Number

Specific Outcome

4N10.Relate decimals to fractions and fractions to decimals (to hundredths). [C, CN, R, V]

4N10.1 Express, orally and in written form, a given fraction with a denominator of 10 as a decimal.

4N10.2 Read decimals as fractions; e.g., 0.5 is zero and five tenths.

4N10.3 Express, orally and in written form, a given decimal in fraction form.

4N10.4 Express a given pictorial or concrete representation as a fraction or decimal.

4N10.5 Express, orally and in written form, the decimal equivalent for a given fraction; e.g., $\frac{50}{100}$ can be expressed as 0.50.

Suggestions for Teaching and Learning

Reinforce the connection between decimals and fractions by having the students write the fraction and the decimal for the shaded part. Conversely, provide the students with decimals or fractions (tenths only) and have them shade the appropriate amounts on the hundredth grids. Encourage them to write the decimal and fraction for the unshaded part and compare the numbers they wrote for the shaded and unshaded parts. For example, if 0.4 is shaded then 0.6 is unshaded. The connection between these two decimals provides the foundation for adding and subtracting decimals.

As stated earlier, fostering understanding of decimals by ensuring that they can be read correctly. Avoid using the term '*point*' when reading a decimal number as it has no mathematical meaning to students. Rather, use the word "*and*" to represent the decimal when reading a number aloud. For example 3.4 should be read as '3 and 4 tenths' not '3 point 4' or '3 decimal 4'. Saying decimal numbers correctly will assist students in gaining an understanding of how decimals relate to fractions.

When writing a decimal less than 1, use a 0 in the ones place to emphasize that the decimal number is less than 1. (i.e. **0**.3 rather than .3)

Students observe ten classmates using criteria similar to those below, and record their results as decimal numbers.

- Number of classmates with brown hair
- Wearing black
- Wearing glasses
- Wearing jewelry
- Etc.

Provide groups of students with counters and egg cartons with the last two compartments cut off. Instruct students to take turns adding counters to compartments, and posing the question "How many?" to other group members. For example, a student may fill 7 compartments of the carton (0.7). Group members may answer "seven tenths". To reinforce the connections between the concrete (egg cartons and counters) and the symbolic representation for decimals, supply students with sheets of tenths grids to record numbers created. To show the connection between decimals and fractions, students may be instructed to first record the number as a fraction then as a decimal number.

General Outcome: Develop number sense

Suggested Assessment Strategies

Resources/Notes

Math Focus 4

Lesson 7
Decimal Tenths
N8 (8.3)
N9 (9.1/ 9.2/ 9.6)
N10 (10.1/ 10.2/ 10.3/ / 10.10.4/ 10.5)
TR pp.46 – 49
SB pp. 230 - 232

Strand: Number

Specific Outcome

It is expected that students will:

4N9 Continued

4N9.1 Write the decimal for a given concrete or pictorial representation of part of a set, part of a region or part of a unit of measure.

4N9.2 Represent a given decimal, using concrete materials or a pictorial representation.

4N9.6 Provide examples of everyday contexts in which tenths and hundredths are used.

4N10 Continued

4N10.2 Read decimals as fractions; e.g., 0.5 is zero and five tenths.

N10.3 Express, orally and in written form, a given decimal in fraction form.

4N10.1 Express, orally and in written form, a given fraction with a denominator of 10 or 100 as a decimal.

4N10.4 Express a given pictorial or concrete representation as a fraction or decimal; e.g., 15 shaded squares on a hundredth grid can be expressed as 0.15 or $\frac{15}{100}$.

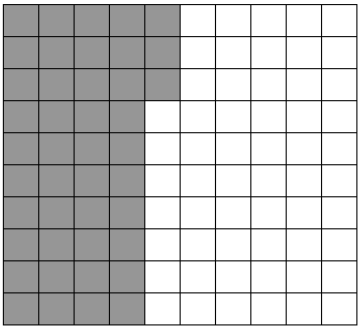
4N10.5 Express, orally and in written form, the decimal equivalent for a given fraction. e.g. $\frac{50}{100}$ *can be expressed as 0.50*

Suggestions for Teaching and Learning

Morning Routine using Decimal Circles – Have each student construct decimal circles as previously described on page 26. Prepare a set of large cards showing decimal amounts less than 1 and using both tenths and hundredths (e.g. 0.7, 0.23, 0.90. 0.4, 0.65 etc). Pick a card and ask students to manipulate the circles to represent the given decimal. Students should hold it up for you to see as soon as they have finished.

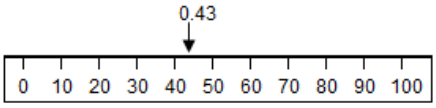
<u>*Roarin' Representations*</u>: Students should be comfortable reading decimal numbers, naming and renaming decimal numbers in alternate ways. Using a hundreds grid and counters, student A should create any decimal number:

Student A



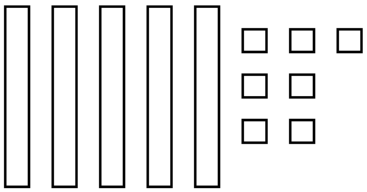
Student B names the decimal number of the covered parts of the hundred grid and then represents the same number using a meter stick or a number line.

Student B



Student C names the decimal number of the uncovered parts of the hundreds grid and is then challenged to show that number using base ten blocks.

Student C



Ask each student to then record the 2 decimal numbers as well as the equivalent fractions. $\frac{43}{100}$ and 0.43

$\frac{57}{100}$ and 0.57

General Outcome: Develop number sense

Suggested Assessment Strategies

Performance
Name that Number: Students may work together to locate 0.5 and 0.6 on a metre stick or measuring tape and decide how to name the points between the two numbers.

Performance
To help students recognize a decimal value, they may colour squares on a 100's grid to create an animal or design. Give decimal values for each color used.

Student-Teacher Dialogue/Journal
Ask "Why are decimals important?" (Possible responses may include "Because they indicate part of a whole", "Because they make an answer more exact", etc.)

Student-Teacher Dialogue
Ask students to solve this problem: You go to the store to buy sugar and find two different brands. Your call your parent but find that they have gone out and are not answering the phone. You have to make a decision about which one is the better buy. One package is marked 0.8kg for $0.78 and the other is marked 0.80kg for $0.87. Which one is the better buy? Using any manipulatives or pictures, explain how you know.

Resources/Notes

Math Focus 4

Lesson 8
Decimal Hundredths
N8 (8.3)
N9 (9.1/ 9.2/ 9.6)
N10 (10.1/ 10.2/ 10.3/ 10.4/ 10.5)
TR pp.50-53
SB pp 233-235

Lesson 7 focused on decimal tenths. Lesson 8 extends focus to include decimal hundredths. Elaborations in lesson 7 can be applicable to both with minor modifications.

Math Game
Race to 1
TR p 58
SB p. 239

Strand: Number

Specific Outcome

It is expected that students will:

4N9 Continued

4N9.1 Write the decimal for a given concrete or pictorial representation of part of a set, part of a region or part of a unit of measure.

4N9.2 Represent a given decimal, using concrete materials or a pictorial representation.

4N9.6 Provide examples of everyday contexts in which tenths and hundredths are used.

4N10 Continued

4N10.2 Read decimals as fractions; e.g., 0.5 is zero and five tenths.

4N10.3 Express, orally and in written form, a given decimal in fraction form.

4N10.1 Express, orally and in written form, a given fraction with a denominator of 10 or 100 as a decimal.

4N10.4 Express a given pictorial or concrete representation as a fraction or decimal; e.g., 15 shaded squares on a hundredth grid can be expressed as 0.15 or $\frac{15}{100}$.

4N10.5 Express, orally and in written form, the decimal equivalent for a given fraction. e.g. $\frac{50}{100}$ *can be expressed as 0.50*

Suggestions for Teaching and Learning

Provide 10 x 10 grids and ask students to shade the part representing four tenths. Identify the decimal number that represents the same amount and be prepared to explain their reasoning. Repeat for other fractions with 10 or 100 in the denominator.

A Grade 4 class went on a hike and made various stops along the route. Jordan and his friend stopped for a break after walking $\frac{2}{10}$ of the route. Jill and Allanah stopped after $\frac{35}{100}$ of the route. Sue took a rest break at $\frac{6}{10}$ of the route. At $\frac{55}{100}$, they stopped for lunch. Their final stop was at $\frac{95}{100}$ where the students waited for the others to catch up. Ask students to write decimal equivalents to represent the stops made during the hike. Extension: Using a skipping rope or a piece of string to represent a number line, and paper clips or clothespins, ask students to plot the decimal equivalents.

General Outcome: Develop number sense

Suggested Assessment Strategies

Portfolio
Using base ten materials, model, then sketch the following decimal numbers:

-three hundredths	-three tenths
-0.33	-0.03

Performance
Tell students that your Grandmother had a button can containing 100 buttons. 60 of them were buttons with two holes, 5 were buttons with four holes and 35 buttons were one holed buttons. Write decimal numbers to show:

- number of buttons with four holes
- number of buttons with two holes
- number of buttons with one hole

Provide the students with several hundred grids. Say various decimal numbers (in context, if possible) for students to represent by shading their grids. Showing cards containing decimal numbers and ask students to read them allowed to you and represent them on a grid, as well.

Performance
Using Decimal Circles as described on page 26, have students turn over the Decimal Circle to see the back and make by estimation a friendly fraction such as $\frac{1}{2}$, $\frac{3}{4}$ and $\frac{1}{4}$. Next, they turn over the Decimal Circle and record how many tenths and how many hundredths were in the section they estimated. Note the colors reverse when the circle is turned over.

Resources/Notes

Math Focus 4

Lesson 8
Decimal Hundredths
N8 (8.3)
N9 (9.1/ 9.2/ 9.6)
N10 (10.1/ 10.2/ 10.3/ 10.4/ 10.5)
TR pp.50-53
SB pp 233-235

Lesson 7 focused on decimal tenths. Lesson 8 extends focus to include decimal hundredths. Elaborations in lesson 7 can be applicable to both with minor modifications.

Math Game
Race to 1
TR p 58
SB p. 239

Strand: Number

Specific Outcome

It is expected that students will:

4N9 (Continued)

4N9.3 Explain the meaning of each digit in a given decimal with all digits the same.

4N9.4 Represent a given decimal, using money values (dimes and pennies).

4N9.5 Record a given money value, using decimals.

4N9.7 Model, using manipulatives or pictures, that a given tenth can be expressed as a hundredth; e.g., 0.9 is equivalent to 0.90, or 9 dimes is equivalent to 90 pennies.

Suggestions for Teaching and Learning

Same is Different: Provide groups of students with base ten blocks. Show students a decimal numeral with all digits the same (e.g. 3.33). Instruct them to model it using base ten materials and to show and explain to the group how much each 3 represents. Repeat several times showing different decimal numbers so that each group member has an opportunity to model a number.

Students will have seen decimals used in dollar amounts but will probably not have thought about their meaning beyond "how many dollars and how many cents?" It is important that students view a dollar/loonie as a whole with a dime representing 0.1 (one tenth) of a dollar, and a penny representing 0.01(one hundredth) of a dollar. Referring to a penny as 'one hundredth of a dollar' instead of a 'cent' will help students understand the fractional part of the whole that the penny represents.

Provide the students with loonies, dimes and pennies. Review the relationship among the coins and focus on groups of ten. Relate these groups of ten to the Base Ten number system. Have the students write symbols for whole number amounts of money, such as $15. Then focus on the necessity of writing values for money less than one loonie or one whole dollar. Explain that the whole number system is extended to accommodate the need to write numbers smaller than one by dividing the whole (dollar) into ten equal parts, called tenths (dimes). Have the students continue this pattern using their understanding of money; i.e., ten pennies make a dime and one hundred pennies make a dollar. Explain that the decimal symbol separates the whole number from the fractional parts called tenths and hundredths. Have the students suggest how they might write 20 cents as a fraction of one dollar, using fractions and then decimals. Guide them to see that it can be written as $\$\frac{20}{100}$ but it is usually written as $0.20, meaning that there are no dollars, but rather two-tenths of a dollar (two dimes) or twenty-hundredths of a dollar (20 cents).

To help students understand that decimals represent a fractional part of a whole, instruct students to fill a 10 by 10 grid with pennies. They should recognize that dimes are worth 0.1 or $\frac{1}{10}$ of a dollar (one row) and that pennies are worth 0.01 or $\frac{1}{100}$ of a dollar (one grid square is worth a penny). Through discussion and observation, students will also see that 0.20 is equivalent to 0.2 or $\frac{2}{10}$, since 20 pennies (0.20) fill two columns.(Small, 2006) **(Continued)**

General Outcome: Develop number sense

Suggested Assessment Strategies

Math Portfolio/Journal:
Using pictures, numbers and words, show the value of each digit in the number 7.77 (or $7.77). (**N9.3**)

Performance:
Identify the number in the tenths place (or hundredths place).
If you have…

- …$2.38
- …$92.29
- …4 loonies, 5 dimes, 6 nickels and 2 pennies
- …2 dimes, 3 nickels and 19 pennies
- …9 dimes, 1 nickel, and 108 pennies

Journal
If we did not use decimals for money, what would happen to prices? (They would be rounded up and we would pay more for things.)

Student-Teacher Dialogue:
Use the 10 x 10 grid and pennies as described on the opposite page and pose questions such as:

- How much are 3 columns?
- If two and a half columns of pennies were removed, how much would be left?
- If the first 4 columns were covered and only six blocks were covered in column 5, what would the value be?

Ask the student to show 0.64 on the grid using any combination of pennies and dimes. Ask if there is a different way to show this amount. (Answers include 6 dimes and 4 pennies or 64 pennies)

Resources/Notes

Math Focus 4

Lesson 9
Representing Decimals with Coins
N9 (9.1/ 9.2/ 9.3/ 9.4/ 9.5/ 9.7)
N10 (10.2/ 10.4)

TR pp.54-57
SB pp 236-238

Strand: Number

Specific Outcome

It is expected that students will:

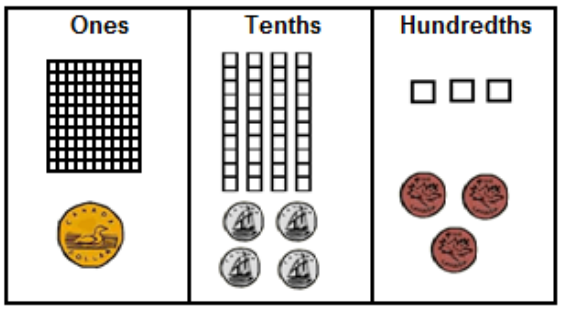
4N10.Relate decimals to fractions and fractions to decimals (to hundredths). [C, CN, R, V]

4N10.2 Read decimals as fractions; e.g., 0.5 is zero and five tenths.

4N10.4 Express a given pictorial or concrete representation as a fraction or decimal; e.g., 15 shaded squares on a hundredth grid can be expressed as 0.15 or $\frac{15}{100}$.

Suggestions for Teaching and Learning

Students may use place value mats to model decimal amounts using both base ten materials, as well as coins.

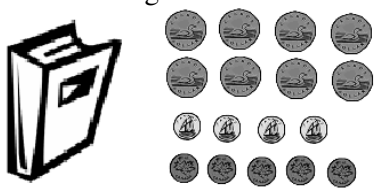


1.43

It is important that students understand and recognize the relationship between tenths and hundredths, as well as between pennies, nickels, dimes and loonies. To help consolidate these connections, use the following activity:

Provide students with sets of play money. (If commercial sets of plastic money are not available, teachers may photocopy sheets from page 29 of Masters Booklet.) Using grocery ads from a newspaper, ask students to show and record at least two ways they could pay for the item. For example, a box of cereal may cost $3.29 and may be paid for using 3 loonies, 1 quarter and 4 pennies. Another possibility may be 2 loonies, 4 quarters, 2 dimes and 9 pennies. The emphasis in this lesson is on representing parts of a dollar as decimals, therefore most of the grocery items students choose should be less than one dollar. If students have difficulty locating products priced less than one dollar, the teacher may create a master list of items and prices that would fit the activity.

Make overhead transparencies of pictures of items as well as pictures of the money used to pay for those items. Instruct students to record how much each item costs using a decimal number.



Likewise, show various decimal values and ask students to model the amount with their play money.

To show that tenths can be expressed as hundredths, ask students to model two ways to show the following decimal numbers as money amounts, using play money manipulatives or pictures of coins:

- 0.3
- 2.9
- 0.7
- 8.5

General Outcome: Develop number sense

Suggested Assessment Strategies

Resources/Notes

Math Focus 4

Lesson 9
Representing Decimals with Coins
N9 (9.1/ 9.2/ 9.3/ 9.4/ 9.5/ 9.7)
N10 (10.2/ 10.4)

TR pp.54-57
SB pp 236-238

Strand: Number

Specific Outcome

It is expected that students will:

4N11 Demonstrate an understanding of addition and subtraction of decimals (limited to hundredths) by:
- **using compatible numbers**
- **estimating sums and differences**
- **using mental mathematics strategies**

to solve problems [C, ME, PS, R, V]

4N11.1 Predict sums and differences of decimals, using estimation strategies.

4N11.3 Solve problems, including money problems, which involve addition and subtraction of decimals, limited to hundredths.

4N11.4 Determine the approximate solution of a given problem not requiring an exact answer.

4N11.5 Estimate a sum or difference using compatible numbers.

Suggestions for Teaching and Learning

By now, most students realize that an exact sum or difference is not always required and an estimate is sometimes sufficient. This is particularly true when adding or subtracting decimal numbers that represent money and distances. When adding and subtracting decimal numbers, students should always estimate first as this requires them to focus on the relationships between numbers and the effect of number operations, rather than simply applying a memorized rule to compute. After estimating, students can add / subtract the decimals to get the exact answer and explain the strategy used to the class or to a partner. Base ten blocks should be available to students at all times during addition and subtraction practice to help them arrive at a solution, as well as model how they found their solutions.

By providing students with many opportunities to estimate sums and differences in meaningful contexts, students will learn to assess which strategy works best, based on the decimal numbers they are working with. They should also recognize the usefulness of these strategies in everyday life, and in doing so, further develop their number sense. When estimating, students will often use mental computation strategies. A number of these strategies were explored in **N3** and can also be used in the context of decimals. Students may choose to use strategies such as:

- compatible numbers: e.g., 0.72 + 0.23 is close to 0.75 + 0.25
- front-end addition: e.g., 32.3 + 24.5 may be thought of as **3**0 + **2**0 (for a more accurate estimate students may add the tenths to get an estimate of 50.**8,** or even 5**1** if they realize that 0.8 is close to 1)
- front-end subtraction: e.g., 4.47 – 3.48 may be thought of as "4 ones minus 3 ones is 1, and 7 tenths subtract 4 tenths is 3 tenths, for a difference of approximately 1 and 3 tenths"
- rounding: e.g., 4.39 + 5.2 is about 4 + 5 for an estimate of 9

Let's Go Shopping! Students may enjoy and benefit from a class 'store' where they may use play money to make purchases. Students may bring in items to 'sell' with a price tag attached, or bring catalogue pictures. Tell students that exact change is not required at this store as long as the clerk and shopper agree on the approximate total price of items purchased. This activity encourages the use of both estimation and mental math strategies.

General Outcome: Develop number sense

Suggested Assessment Strategies

Portfolio
Create addition or subtraction equations using decimal numbers that would result in an answer close to 50.

Performance/Interview/Paper Pencil
Pose questions such as the following:

- Becky earned $127 in one week of babysitting and has $248 in the bank. She wants to buy a $400 bicycle. Will she have enough money?
- Jason's favorite comics cost $2.17 on sale. He wants to buy two of them. About how much will they cost?
- Beth has $153 in the bank. She has to pay her mom back for a $49.98 pair of sneakers, and wants to buy her brother a $28.38 logo t-shirt for his birthday. She wants to go to Science camp, which will cost $65. Does Beth have enough money?

Student-Teacher Dialogue

- Show: 26.5 + 53.5
  Ask: "How can you know that the sum is less than 100 without actually completing the addition?"

- How would you calculate 4.97 + 6.99 mentally?

Journal

- Tell students that to calculate 9.7 – 8.6, Bethany thought '86 + 11 = 97'. Explain her thinking.

Resources/Notes

Math Focus 4

Lesson 10
Estimating Decimal Sums and Differences
N11 (11.1/ 11.3/ 11.4/ 11.5)
TR pp.59 -62
SB pp.240 - 242

Lesson 11
Using Mental Math
N11 (11.3)
TR pp.63-66
SB pp.243-245

Strand: Number

Specific Outcome

It is expected that students will:

4N11 Continued

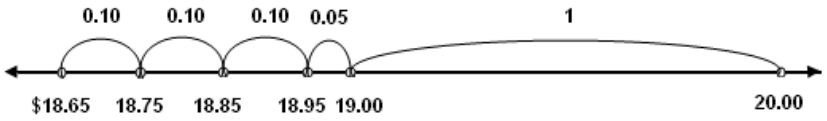
4N11.3 Solve problems, including money problems, which involve addition and subtraction of decimals, limited to hundredths.

4N11.6 Count back change for a given purchase.

Suggestions for Teaching and Learning

Focus on the value of estimating to determine how much change one would receive after a purchase, as well as determining the exact amount of change. Students will have many opportunities to calculate mentally with decimals, with the goal of arriving at an estimate and being able to explain why the answer is reasonable.

To find an exact answer, students may choose to "count on" to calculate change and may use a number line to help them record the jumps taken when counting on. The number line in this case will probably not resemble the traditional number line with even intervals. For example, if a student were to use a number line to help calculate change from $20 for a purchase of $18.65, it may look like this:



To help students further develop their own personal strategies for calculating change, and to reinforce the strategy of "counting on", teachers could supply groups of students with a catalogue and play money. Ask them to make three separate purchases from the catalogue, pay for each and check that the 'clerk' gave them the correct change, by counting on aloud for group members to hear. Highlight with the class any strategy that may be unfamiliar or different than those the majority would use.

Let's Go Shopping! If the class 'store' was established, encourage students who visit there to estimate first what their change will be, then calculate the exact amount. The 'clerk' will determine whether or not the change is correct.

Build It to Show It: Supply group members with price tags (cards) showing decimal amounts such as $0.03, $0.40, $1.12, $2.49, $4.99, etc. Cards are placed face down in a pile. The first player turns over a card and uses base ten blocks to build the number shown. Group members discuss what would be 'added on' to get to a loonie, toonie, $5.00, $10.00 and so on, depending on the amount shown on the card. The first member then builds that amount with base ten blocks to show the change one would receive if making a purchase of an item priced like the one on the card. Each group member could then write an equation to represent the round.

General Outcome: Develop number sense

Suggested Assessment Strategies

Performance
Provide students with the following problem: Tess bought a CD for $22.35. She paid for it with two twenty-dollar bills. What was her change? Using models, number lines, words and pictures, explain how you solved the problem. What other bills might Tess have used to pay for her purchase? What would her change have been then?

Interview
Ask students to calculate the change from $5.00, if the bill totaled $3.59.

About How Much? Show students a short list of grocery items. Ask students to estimate about how much the list will cost. This may lead to an interesting discussion about the cost of groceries! Next, students check their predictions. Ask: How did you determine the total cost? Encourage discussion and explanation of the strategies students used to estimate and to add mentally. Ask: Will I have enough money if I only have $20? How do you know?

About how much change will I have if I pay with $20? $50? $100? Show how you know.

Resources/Notes

Math Focus 4

Lesson 12
Making Change
N11 (11.3/ 11.6)
TR pp. 67-70
SB pp. 246-247

Strand: Number

Specific Outcome

It is expected that students will:

4N11 Continued

4N11.3 Solve problems, including money problems, which involve addition and subtraction of decimals, limited to hundredths.

4N11.5 Estimate a sum or difference using compatible numbers.

Suggestions for Teaching and Learning

It is important that students recognize that the properties and techniques established for the addition and subtraction of whole numbers also apply to decimals. Students should recognize that adding or subtracting **tenths** (e.g., 3 tenths and 4 tenths are 7 tenths) is similar to adding or subtracting quantities of other items (e.g., 3 apples and four apples are 7 apples). The same is true with **hundredths**. Rather than simply telling students to line up decimals vertically, or suggesting that they "add zeroes", they should be directed to think about what each digit represents and what parts go together. For example: 1.62 + 0.3 may be thought of as 1 whole, 9 (6 + 3) tenths and 2 hundredths, or 1.92. Base ten blocks and hundredths grids continue to be useful models. Once students recognize these similarities, addition and subtraction equations should be given to students in horizontal form so they can practice aligning the decimals vertically when calculating (e.g., 2.5 + 17.36). It is particularly important that students estimate to determine the reasonableness of their answer (e.g., 2.5 + 17.36 may be thought of as 3 + 17 = 20).

Place a strip of wide masking tape on the floor to represent a number line. With endpoints of 14 and 16, divide the line into tenths. Pose this problem: The city record for the 100-metre run is 15.9 seconds. Derek ran the race in 14.6 seconds. By how much did Derek beat the record?

Let's Go Camping: Ask students to make a list of supplies they would need to take on a camping trip. Research the prices using catalogues and calculate the cost.

Supply students with a list of average temperatures for towns/cities they may study as part of Social Studies:

Place	Average temperature in May in degrees Celsius
Great Barrier Reef, Australia	25.1
Edmonton, Alberta	10.7
Nairobi, Kenya	19.5
Oslo, Norway	12.3

Ask questions such as:

- In May, how much warmer is it in Australia than in Alberta?
- Would the combined temperatures of Nairobi and Oslo be greater or less than 30? How do you know?
- How much colder is Edmonton than Oslo?

General Outcome: Develop number sense

Suggested Assessment Strategies

Performance
Luci loves to hike. Her goal is to hike 15 kilometres on weekends. She keeps track of her weekend hiking distances:

	Saturday	Sunday
First Weekend	4.9 km	3.81 km
Second Weekend	7.19 km	5.8 km
Third Weekend	9.3 km	5.9 km
Fourth Weekend	8.42 km	6.6 km

Did Luci reach her goal? On which day(s)? Show how you solved the problem.

Portfolio/Journal
Ken's solution to an addition question is shown below. Write to Ken and explain what he did wrong and show him through numbers, pictures and words how to solve the problem.

$$\begin{array}{r} 0.78 \\ +\ 1\ 2.3 \\ \hline 2.01 \end{array}$$

Interview
How is calculating 0.3 + 0.8 like calculating 3 + 8?

Journal
Is the difference between 1.8 and 0.52 greater than 1 or less than 1? Show how you know.

Paper-Pencil
Provide short grocery receipts. Students can sort items on the receipt into categories of their choice and then figure out how much was spent in each category. This may be used as a cross curricular activity with a discussion of the food groups or nutrition in Health.

Paper-Pencil
Make several sport cards available and ask students to compare sports statistics among two players. E.g. compare batting averages using addition and subtraction.

Resources/Notes

Math Focus 4

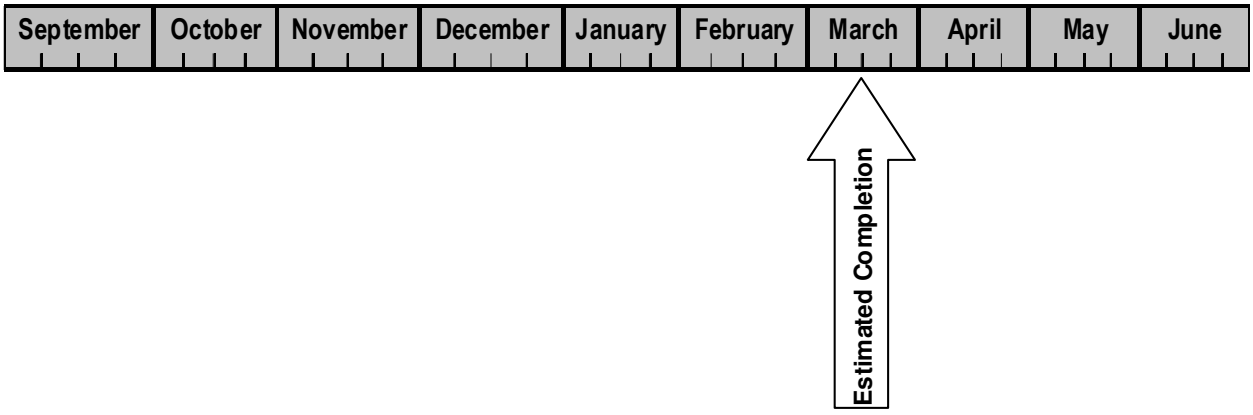
Lesson 13
Adding and Subtracting Decimals
N11 (11.3/ 11.5)
TR pp. 71-74
SB pp. 248-250

Chapter Review

Chapter Task

MEASUREMENT

Suggested Time: approx 3 weeks



Big Idea

Measurement is a fundamental mathematical process that is an essential link to many areas of the mathematics curriculum. Measurement permeates many areas of life including careers and everyday living. In its simplest form it merely attaches a number to some attribute of an object and it increases in it's breadth and depth as students move on through the curriculum. Students also must learn proficiency in choosing and using measurement tools. Although measurement is the focus of this unit, it should be continued throughout the school year as it relevant in other areas of the mathematics curriculum as well as everyday experiences.

In this unit, measurement is addressed first as it relates to measuring time. "Standard units of time should always be introduced to children in a way that relates to their own experiences." *(Small, 2008, p. 444).* Then measurement is taught as it relates to the measurement of area. Measurement skills are best learned by students if they have plenty of opportunities to complete activies focusing on measurement. They most often learn best by first hand experience. Although students have not had any explicit teaching related to reading and recording time using clocks by grade four, they have had opportunities in previous grades to explore the passage of time and have an understanding that there are 60 minutes in an hour. As well, students will have had many opportunities to use time through their own experiences with the real world. The units, "minutes and hours", are usually introduced before the unit "seconds" because children use them more often throughout their daily lives.

Students will need to learn these standard units of time and then have many opportunities to explore the relationship among the units. Throughout the school day, teachers need to provide numerous opportunities for students to read and record time using a variety of clocks such as digital, analog and 24 hour clocks. Embedded throughout this unit is a focus on how the measurement of area can be used to solve problems. Students should read times on clocks to provide information about relevant situations such as:

- comparing start and finish times to determine how much time has passed
- estimate how long before an event begins, e.g., How long until lunchtime?
- planning events
- reading schedules

The concept of area measurement for regular and irregular shapes is introduced in this unit as well. Students' previous experience with measurement units would have dealt mainly with linear measurements, including perimeter.

Van de Walle and Lovin, 2006 define area as "a measure of the space inside a region or how much it takes to cover a region. *(p. 234)*

In using any type of measurement, such as length, area or volume, it is important to discuss the similarities in developing understanding of the different measures. First, identify the attribute to be measured, then choose an appropriate unit and finally, compare that unit to the object being measured (NCTM 2000, p. 17). As with other attributes, it is important to understand the attribute of area before measuring.

Key ideas in understanding the attribute of area include the following:

- conservation – an object retains its size when the orientation is changed or it is rearranged by subdividing it in any way
- iteration – the repetitive use of a identical nonstandard or standard units of area to entirely cover the entire surface of the region
- tiling—the units used to measure the area of a region must not overlap and must completely cover the region, leaving no gaps
- additivity—add the measures of the area for each part of a region to obtain the measure of the entire region
- proportionality—there is an inverse relationship between the size of the unit used to measure area and the number of units needed to measure the area of a given region; i.e., the smaller the unit, the more you need to measure the area of a given region
- congruence—comparison of the area of two regions can be done by superimposing one region on the other region, subdividing and rearrangement as necessary
- transitivity—when direct comparison of two areas is not possible, use a third item that allows comparison; e.g., to compare the area of two windows, find the area of one window using nonstandard or standard units and compare that measure with the area of the other window; i.e., if A = B and B = C, then A = C
- standardization—using standard units for measuring area such as cm^2 and m^2 facilitates communication of measures globally
- unit/unit-attribute relations—units used for measuring area must relate to area; e.g., cm^2 must be used to measure area and not cm or mL.

Adapted from Alberta Education, *Teaching Measurement Concepts, Grades 4–6* (unpublished workshop handout) (Edmonton, AB: Alberta Education, 2006), Research section, pp. 2–4.

Process Standards Key

[C] Communication
[CN] Connections
[ME] Mental Mathematics and Estimation
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

Strand: Shape and Space (Measurement)

Specific Outcome

It is expected that students will:

4SS1 Read and record time, using
digital and analog clocks, including 24-hour clocks
[C, CN, V]

Achievement Indicators:

4SS1.1 State the number of hours in a day.

4SS1.2 Express time orally and numerically from a 12-hour analogue clock.

Suggestions for Teaching and Learning

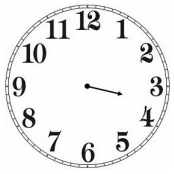
Time can be represented using a linear model such as a timeline because time is actually linear however our 'descriptions' of time with words such as days, weeks, months, years, etc. describes cycles. This is a common misconception. Although time is linear because nothing actually repeats, we still can use a 'time circle' when teaching time to show the cyclical nature of the words that are 'descriptions' of time.

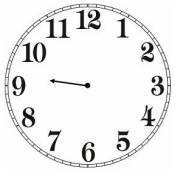
Students will learn that there are 24 hours in a day; however, time is often described using the 12-hour clock. Although the world has become increasingly digital, there are still may analogue clocks in use and students must learn to tell time on both analogue and digital clocks as well as on a 24 hour analogue clock which will be discussed later. On a 12 hour analogue clock, the hours go from 1:00 in the morning until 12:00 noon and then it repeats the cycle from 1:00 in the afternoon until midnight.
Consider setting an alarm clock to alarm every hour on the hour. Count how many hours are in a school day and use that information to conclude that there are 24 hours in one day.

Van de Walle & Lovin K-3 (2006 page 244) suggests using a "one-handed clock" to help students understand and read analogue clocks. Discuss what happens to the long hand as the short hand goes from one hour to the next. Often students do not position the hour hand to reflect the number of minutes after the hour. Discuss with them how the hour hand moves over the course of each hour. If available, use a geared demonstration clock. Also, break the long hand from an old clock and set the short hand in varying places as shown below and use approximate language such as:

"It's about 8 o'clock"

"It's halfway between 3 o'clock and 4 o'clock"





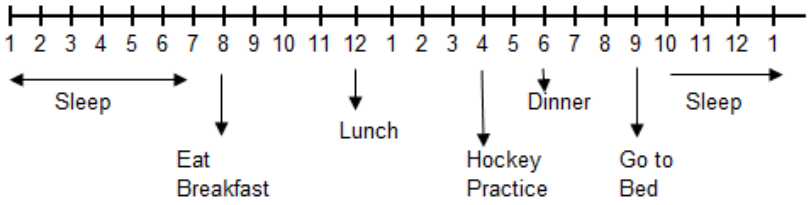
"A little bit past 9 o'clock"

General Outcome: Use Direct or Indirect Measurement to Solve Problems

Suggested Assessment Strategies

Performance
Have students track events throughout a specific day by means of a time line. Students should record the time of the activity or event and note it at the appropriate spot on a time line.

Encourage the children to use different colours for the a.m. and p.m. hours.



(SS.1)

Ask students how many hours are in a day and a half? Two days?
(SS1.1)

Example: 2:10 a.m. is "Two ten" or "Ten minutes past two." Note that a.m. and p.m. still need to be indicated.

Consider:
- 5:03 might be said as "3 minutes after 5"
- Can students express 7:40 as "twenty minutes to eight"?
- How would "10 minutes to 8" be written?
- Would students know that 7:57 means "nearly 8:00?"

(SS1.2)

Performance
Using masking tape, form a large clock on the floor. Use a metre stick for the long hand and a ruler for the short hand. Have students take turns and work in pairs to make the clock show a time you call out. Involve all the students by having them make the time on individual paper plate clocks at the same time.
Variation: Use two children, one taller than the other, to stand in the center of the clock to represent the hands on the clock. Ask: Who should be the minute hand? Why? (the taller child because the minute hand is longer – be sensitive to children who might be embarrassed about being tall or short). Where should the minute hand point to show 1:00? (to 12). Where should the hour hand point to show 1:00? (to 12). Pass out index cards showing various times. Children hold up the time cards one at a time and tell the children representing the hands where they should point to show the time. (SS1.2/ SS1.2)

Resources/Notes

Math Focus4

Lesson 1
Telling Time to the Hour
SS1 (1.1/ 1.2/ 1.7/ 1.8)
SB p.262-264
TR p.12-15

Sources:
Teaching Student-Centered Mathematics K-3, Van de Walle and Lovin, 2006, pp.242 - 245

Making Math Meaningful to Canadian Students K-8, Marion Small, 2008, pp. 441 - 448

Strand: Shape and Space (Measurement)

Specific Outcome

It is expected that students will:

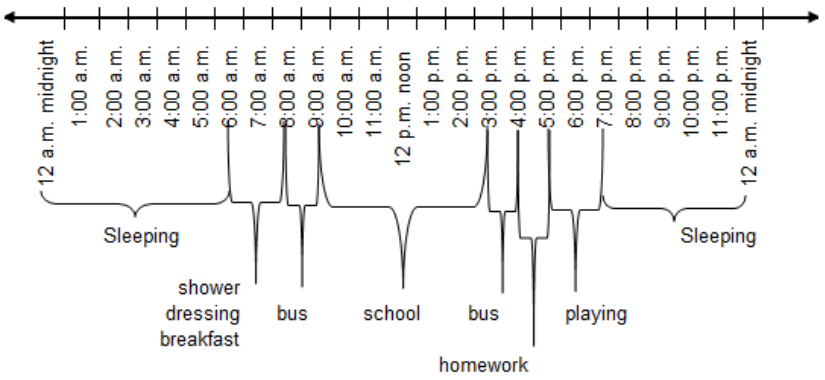
4SS1 Continued

Achievement Indicators:

4SS1.7 Explain the meaning of a.m. and p.m., and provide an example of an activity that occurs during the a.m., and another that occurs during the p.m.

Suggestions for Teaching and Learning

Students may want to investigate the meaning of the terminology **a.m.** and **p.m.** [a.m. is the abbreviation for the Latin *ante meridiem* meaning before noon and p.m. is the abbreviation for *post meridiem* meaning after noon]. Students will likely encounter other representations of a.m. and p.m., such as AM and PM; A M and P M [with or without periods/ capitals/lower case]. Students can use the terms "noon" and "midnight" for those precise times since the use of 12:00 a.m. and 12:00 p.m. may be a source of confusion.
A good way to investigate a.m. and p.m. is to use a full-day timeline. This helps students become familiar with using a.m. and p.m. notation correctly. It also helps students who confuse a.m. with p.m. (Small, 2008)



Students would benefit from ongoing practice telling time during morning/ daily routines through the use of a demonstration clock. If you prefer, make an overhead clock by photocopying a clock template and separate hands on transparencies. Cut out the hands and attach them with a fastener so that they are moveable.

General Outcome: Use Direct or Indirect Measurement to Solve Problems

Suggested Assessment Strategies

Ask students to name an activity they would typically do in the a.m.? p.m.?

Resources/Notes

Math Focus4

Lesson 1 (Cont'd)

Curious Math
SB p.265
TR p.16

Authorized Resources:

Van de Walle, Teaching Student-Centered Mathematics, Grades K-3, pp. 242-244

Other Resources:
Marian Small, Making Math Meaningful to Canadian Students K-8, pp. 441-452

NCTM, Navigating through Geometry in Grades 3-5 (2003)

Van de Walle, Teaching Student-Centered Mathematics, Grades 3-5 pp. 269-271

Strand: Shape and Space (Measurement)

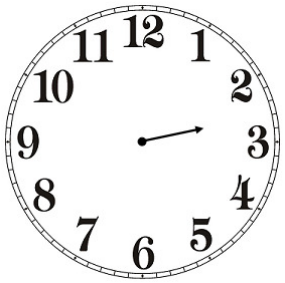
Specific Outcome	Suggestions for Teaching and Learning
It is expected that students will: **4SS1 Continued**	
4SS1.2 Express the time orally and in writing from a 12-hour analog clock.	Students need to learn how to express time using a 12-hour analog clock. Students have had experiences telling time to the hour but time that falls between the hours is more challenging for students; therefore, it is important to take time to analyze, with students, how the analog clock shows the passage of the standard units of time. Building student's conceptual understanding of analog time helps students make sense of time related terms. e.g. 8:15 can also be read as "a quarter past 8" Expressing time orally offers an excellent opportunity for students to use their bodily-kinesthetics to visualize and solve problems relating to time on an analog clock. Introduce the terms "half past", "quarter after" and "quarter to" using an analog clock. Provide an open space for creative movement where children can sit on the floor and then arrange themselves to represent the numbers and hands on a clock. Once they have physically arranged themselves, ask them to show various times on a clock. For a student to relate 8:15 to a quarter past 8, they would need to know that 15 minutes is $\frac{1}{4}$ of 60 minutes.
4SS1.6 Express the time orally and in writing "minutes to" or "minutes after" the hour.	If the time falls more than halfway through the hour, we read it as a number of "minutes to" one hour, or as a number of "minutes after" the previous hour. Students need to be very attentive to the hand lengths, as well as the numbers on an analog clock. They need to learn that whether they read the number as an hour or as minutes will depend on which hand is pointing to the number. Students should not be limited to reading time to the nearest five minutes if they show a good understanding. They can be encouraged to read time to the minute. Have students explore that the minute hand and hour hand on an analog clock are different lengths and that the minute hand is at 6 for the _:30 and at 12 for the _:00. Students need to be aware that the hour hand moves during the course of the hour, and when it is at the _:30, it is halfway between two numbers. Time after the hour and time before the hour should be addressed. Examples: 8:45 might be spoken as "eight forty-five"; "forty-five minutes past eight"; "quarter to nine"; or "fifteen minutes to nine" Have students work in pairs. Have one student say a time and the other student make the time on the clock.

(Continued)

General Outcome: Use Direct or Indirect Measurement to Solve Problems

Suggested Assessment Strategies

Paper-Pencil - One-Handed Clocks: Prepare a page of clock faces and on each analog clock draw on an hour hand (short hand) only. Include times that are approximately a quarter past the hour, a quarter to the hour, half past the hour and some that are close to but not on the hour. Ask students to write the possible digital time and then draw a minute hand on the analog clock where they think it would be so both clocks will be displaying the same time. Practice this activity of reading approximate time daily during morning/daily routines many times before having students attempt it independently. If students have difficulty, try pairing the one handed clock with a two handed clock and a digital clock. (SS1.2/SS1.7)
For example:



Performance
Ask students to predict the reading on a digital clock when shown an analog clock and vice versa, set an analog clock when shown a digital clock. At various times throughout the day, uncover one clock and have students predict, orally or in writing, what's happening on the other clock.

Student-Teacher Dialogue
Using two real clocks, one with only an hour hand (break off the minute hand from an old clock) and one with two hands, cover the two handed clock and periodically throughout the day, direct attention to the other one-handed clock. Have students predict where the minute hand should be and then uncover the two-handed clock and check.

Resources/Notes

Lesson 2
Time to the Hour and Quarter Hour
SS1 (1.2/ 1.6 1.8))
SB p.266-267
TR p.17-19

Lesson 3
Telling Time to 5 Minutes
SS1 (1.2/ 1.6/ 1.8)
SB p.268-270
TR p.20-22

Lessons 2 and 3 may be addressed together.

Strand: Shape and Space (Measurement)

Specific Outcome	Suggestions for Teaching and Learning
It is expected that students will: **4SS1 Continued**	It is essential for teachers to provide many opportunities for students to manipulate the hands of an analog clock to help them visualize how the hour hand moves in relation to the minute hand. Ask students what time it might be if: • the minute hand is pointed to an area between 4 and 5 • the hour hand and minute hand are both pointed directly at a number Using a clock that shows not only the numbers from 1-12, but also the minute amounts from 5-55 beside the numbers from 1-11 may be useful. As students establish a comfort level with skip counting by 5, this will enable them to read time to the nearest five minutes. This provides students with an opportunity to relate the numbers on a clock to time. Students may have already become familiar with the 'clock strategy' as one mental math strategy for learning multiplication of 5x facts. This would be an appropriate time for teachers to make students aware that there are 5 minutes between numbers on a clock. The long hand on the 2 represents 10 minutes, so two one minute spaces past the 2 is 12 minutes. Show students a standard analog wall clock, drawing attention to the hour and minute hands and how they relate to the previous activities. As time telling skills develop, continually suggest to students to look first to the hour hand to predict an approximate time and then to the minute hand for precision.

General Outcome: Use Direct or Indirect Measurement to Solve Problems

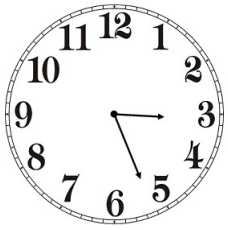
Suggested Assessment Strategies

Performance
Initially have students read the time from a one-handed analog hour clock. Ask him/her to read the time to the nearest hour and to name an event/activity that often happens at about that time of day. This approach helps students to attend to the placement of the hour hand and its meaning. Encourage students to verbalize phrases such as:
- "before eight o'clock"
- " between eight and nine o'clock"
- "a few minutes after eight o'clock"
- "precisely eight o'clock"
- "nearly eight o'clock"
- "about half past eight"
- "about eight thirty"

Note misconceptions to guide teaching by listening closely to student responses. (SS.1.2)

Performance
- Ask the student to show, on an analog clock, the time (to the nearest half hour) at which they arrive at school, have lunch, go to bed, etc.
- Have the student make a list of the times when the minute hand and the hour hand just about line up as well as other patterns, such as all of the times that include a 4 in a 24-hour period.
- Ask students what time might it be if the minute hand and hour hand are opposite one another.
- Provide students with many opportunities to use hands-on manipulatives such as play clocks and clock stamps to express time orally and in writing. Then listen as students read the times on the various clock cards.

Student Teacher Dialogue
Display clock as shown:



- Where is the hour hand? (A little past 3)
- What does that tell you? (It's after 3:00)
- How much after 3:00 is it? (It's twenty five minutes after 3)
- How do you know? (The minute hand is pointing at the 5)

Resources/Notes

Strand: Shape and Space (Measurement)

Specific Outcome

It is expected that students will:
4SS1 Continued

4SS1.4 Express the time orally and in writing form, from a 12-hour digital clock

4SS1.8 Solve problems related to time including elapsed time

Suggestions for Teaching and Learning

Ask students to think about some different kinds of clocks or watches they have seen. Students find it easier to 'read' times from a digital clock but it is important to talk about the meaning of the times they are reading. Using an analog and a digital clock together may help with this. Having a real digital clock available for students to manipulate would be beneficial.

Reading a clock, or 'telling time' is more about reading an instrument. Time as a measurement; however, encompasses duration. For students to make sense of the concept of time, they need to understand that **time, as a measurement, is about how long an event takes from beginning to end**. This is called **Elapsed Time.**. Elapsed time can be found only by counting the hours and minutes between the start and the end times. Much of the learning that students are to attain can be assessed on an on-going basis through daily conversations and activities in which time is naturally included

Initiate a discussion about a recent birthday invitation. Show students a birthday invitation that you have received. Ask the students: What information did the birthday invitation give? Focus on the start and end time for the party. Provide a 4-column chart and model how to use it to record each event, its start and end times and the elapsed time Next, brainstorm a list of student events and have them complete the chart..

Activity	Start Time	End Time	Elapsed Time
birthday party	4:00	6:00	2 hours
soccer practice			
school lunch			

Provide the students with clock manipulatives to use.
Invite children to share their charts and then discuss the strategies they used to determine the elapsed time.
By making conscious efforts throughout the school day, teachers can provide numerous opportunities for students to learn duration of short and long events that can be measured in second, minutes and hours.

Students should read times on various clocks to provide information about relevant situations, such as:

- comparing start and finish times to determine how much time has passed
- estimating how long before an event begins [e.g. How long until lunch time?]
- planning events
- reading schedules [bus, travel itinerary, school timetable, television, etc.]

General Outcome: Use Direct or Indirect Measurement to Solve Problems

Suggested Assessment Strategies

Performance/Presentation
This task encourages exercise and can be done as a class or can be modified to be done at home (with parent permission). Have students brainstorm to pick a reasonable location within walking distance from the school. Choose one clock to be the official clock. Students record the time, to the minute, they leave school. They walk to their destination and record the time they get there, to the minute. After arriving back at school use this information to figure out how much time it took them to walk to their destination (how much time had elapsed). Hint: Leaving before noon and returning after noon, would provide an opportunity to assess students' appropriate use of a.m. and p.m.! For example, leave school at 11:30 a.m. and return at 12:06 p.m. As a follow up, if you have access to an inexpensive wrist watch, assign each student a day to wear the watch home. The next morning during daily routines, the student should present recorded times that he/she left school the previous day, the time he/she arrived home, tell how much time had elapsed and show or tell how they knew. You may use a digital clock, an analogue clock or a 24 hour clock (after working on this in class) depending on the needs of your class or individual student. This task provides you with an opportunity to assess students' understanding of time as students read different types of clocks and compute elapsed time.

(1.2/ 1.4/ 1.6/ 1.8)

Performance
Using an index card, ask students to create a story problem involving elapsed time. Then trade their cards with other students to have them solve the problem. (1.8)

Performance
Refer to the class clock frequently throughout the day and ask questions such as, "What time will it be in 20 minutes?" or, "Our math class started at 9:30. How long did it last?"
Make clocks available (students may make their own using a paper plate). At various times during the day, preferably on the hour or half hour ask questions such as the following.
It is 10:00 now. What time will it be:

- 2 hours from now
- $4\frac{1}{2}$ hours from now
- 12 hours from now
- 10 minutes ago
- 2 hours ago
- $1\frac{1}{2}$ hours ago

(1.2/1.6/1.8)

Resources/Notes

Lesson 4
Telling Time to 1 Minute
SS1 (1.2/ 1.4/ 1.6/ 1.8)
SB p. 272-275
TR p. 24-27

Strand: Shape and Space (Measurement)

Specific Outcome	Suggestions for Teaching and Learning
It is expected that students will: **4SS1 Read and record time, using digital and analog clocks, including 24-hour clocks (Cont'd)** [C, CN, V] *4SS1.3 Express the time orally and in numerically from a 24-hour analogue clock.* *4SS1.5 Express time orally and numerically from a 24-hour digital clock.*	It is important for students to learn about the 24 hour time system. The 24 hour clock is a system used for telling time in which the day runs from midnight to midnight and is numbered from 0 to 23. It is often used when it is very important that times are not confused. The 24-hour clock eliminates uncertainty as there is only one 11:32, for instance, during the day. Students may have encountered everyday life situations where the 24 hour time system is used if they have traveled on flights and ferries. It is also used in the practice of medicine because it helps prevent ambiguity about important events in a patient's medical history. This system is sometimes referred to as 'military time'. Ask students why using a 24-hour clock in the military would be important. Some students who struggle with the 12 hour clock can be exposed but may not be ready to work on the 24 hour clock. Once students are comfortable reading the 24 hour clock, they may observe that subtracting 12 is a convenient way to "tell" the more familiar 12 hour time. In the 24-hour notation, a time of day is written in the form hh:mm (for example 22:30) where 22 means 22 full hours have passed since midnight and 30 full minutes have passed since the last full hour. Note that digital time is always expressed with 4 digits with a "0" being placed at the beginning of times less than 10. For example, 8:00 is expressed as 08:00 hours.
It is expected that students will: **4SS2Read and record calendar dates in a variety of formats** [C, V]	Using a calendar throughout the school year will strengthen the students' sense of time. Each month brings a new calendar to explore. Students need to become aware of the variety of ways dates can be recorded. Students would have previous experience relating the number of days to a week; number of months to a year; days to a month. The calendar also provides rich opportunities to explore: - number sense [See also N 5] - number patterns [See also PR 1.4 & PR 3.2]

General Outcome: Use Direct or Indirect Measurement to Solve Problems

Suggested Assessment Strategies

Performance
Provide a chart such as the one shown on the right of the page, with some of the times missing and ask students to fill in the empty spaces. (SS1.5)

24 hour clock	12 hour clock
00:00	12:00 a.m. 12 midnight (start of day)
01:00	1:00 a.m.
02:00	2:00 a.m.
03:00	3:00 a.m.
	4:00 a.m.
	5:00 a.m.
06:00	
07:00	
08:00	
	9:00 a.m.
10:00	
11:00	
12:00	
13:00	1:00 p.m.
	2:00 p.m.

Performance
Ask the student to move the hands of an analog clock to match the time shown on a digital clock. Ask students to express the time orally and numerically that has been created on a 12-hour analog clock, 24-hour analog clock, and 12-hour digital clock. (SS1.3)

Student-Teacher Dialogue
Discuss when a 24-hour clock would be more appropriate to use than a 12-hour clock. (SS1.3)

Portfolio
Have students work individually to create a number line. Provide ribbon, clips and the following index cards and have students clip cards to the ribbon in appropriate places.

- 00:00 hrs -24:00 hrs
- 12 a.m. - 12 p.m.
- Recess -school ends
- Lunch (SS1.3)

Student-Teacher Dialogue
Ask students what they might be doing when the clock reads 3 p.m.? 2 a.m.? (SS1.7)

Performance
Ask students to work in pairs to set up a schedule, using the 24-hour system, in which every student will get 30 minutes on the computer, starting at 10:00 hours. Ask:

- Can all students in our class have computer time before noon, and if not, how long will it take to finish after lunch?
- What time will the last student finish? (Remind them to leave time for recess) (1.8)

Resources/Notes

Lesson 5
Writing Dates and Times
SS1 (1.1/1.3/1.5/1.7)
SS2 (2.1/2.2/ 2.3)
SB p. 276-278
TR p. 28-31

Strand: Shape and Space (Measurement)

Specific Outcome

It is expected that students will:

Achievement Indicators:
4SS2 Continued

4SS2.1 Write dates in a variety of format .E.g:

- *yyyy/mm/dd*
- *dd/mm/yyyy*
- *dd/mm/yy*
- *March 28, 2007*

4SS2.2 Relate dates written in the format yyyy/mm/dd to dates on a calendar.

4SS2.3 Identify possible interpretations of a given date; e.g., 06/03/04.

Suggestions for Teaching and Learning

Writing dates in a numeric representation is faster than writing words and is often in use today. Have students explore newspapers, receipts, school registration forms, etc. to see how the dates are written. Consider numeric dates, as they appear in different forms, such as registration for school, newspapers, receipts, etc. and how many have different interpretations. It is important to note the confusion that the different combinations of numerals might cause.
On an ongoing basis, encourage students to date their work in different formats.

Example:
Show 2008/06/23 – Have students read the numeric date and circle the corresponding date on a calendar. Repeat for other dates.

Example: 06/03/04 might mean 6th March, 2004 or June 3rd, 2004 or March 4th, 2006

While discussing numeric dates, it might be worthwhile for students to learn the words to "Thirty days hath September" which is still used by many adults to prompt them into recalling how many days there are in each month! The origin of the lyrics to “Thirty days hath September” is obscure but the use of olde English can date this poem back to at least the 16th century. There are many slightly differing variations. Here is one:

Thirty days hath September,
April, June and November;
All the rest have thirty-one
except February alone which hath 28
and sometimes 29

Or students might enjoy the “Knuckle Method” for remembering the number of days in each month:
Make a fist showing four knuckles; start by pointing to the first knuckle and saying, “January.” The space between knuckles is February; the second knuckle is March, and so on. After saying, “July,” go back to the beginning, making August land on the first knuckle and continuing until year end. The months that land on the knuckles each has 31 days.

General Outcome: Use Direct or Indirect Measurement to Solve Problems

Suggested Assessment Strategies

Performance
Ask students to play a concentration game to match calendar dates that are written in a variety of formats
e.g. yyyy/mm/dd; 06-03-09; dd/mm/yyyy; June 3, 2009
(2.1/2.1/2.3)

Journal
Send students on a scavenger hunt and ask them to bring in different dates from magazines, posters, items printed from the internet, cheques, and newspapers. Then share, discuss and display the variety of formats as a class.

Ask students to explore what calendar dates can be confused with other dates when they are interpreted using various formats.

Journal
- Ask students to write about their favourite format for recording a calendar date and explain their choice.

Performance
- Show the student a calendar for the year. Ask him/her to point out the day's date and have them record it using one of the formats:
  - dd/mm/yy
  - yyyy/mm/dd
  - dd/mm/yyyy
  - May 23, 2009

Pencil-paper
Ask students to write their birth date using the different formats.

Resources/Notes

Lesson 5
Writing Dates and Times
SS1 (1.1/ 1.3/ 1.5/ 1.7)
SS2 (2.1/2.2/ 2.3)
SB p. 276-278
TR p. 28-31

Math Game
It's About Time
SS1
TR p. 32
SB p. 279

Strand: Shape and Space (Measurement)

Specific Outcome

It is expected that students will:

4SS3 Demonstrate an understanding of area of regular and irregular 2-D shapes by:

- **recognizing that area is measured in square units**
- **selecting and justifying referents for the units cm^2 or m^2**
- **estimating area, using referents for cm^2 or m^2**
- **determining and recording area (cm^2 or m^2)**
- **constructing different rectangles for a given area (cm^2 or m^2) in order to demonstrate that many different rectangles may have the same area.**

[C, CN, ME, PS, R, V]

Achievement Indicators:

4SS3.*1 Describe area as the measure of surface recorded in square units.*

Suggestions for Teaching and Learning

At the grade 4 level, students should participate in explorations that serve to deepen and expand upon previously learned measurement ideas and skills. Through investigations, students should come to understand that **area** refers to: "a measure of the space inside a region or how much it takes to cover a region." (Van de Walle & Lovin, 2006, p. 234)

Select and design activities which help students to make sense of what the real life applications of finding the area measurement of something is. Have the students share some everyday contexts in which people need to know the amount of surface covered, such as painting a wall or tiling a floor. Encourage students' development of ways to determine area by providing concrete experiences. In learning how to measure, students should be actively involved. Have squares of paper, tiles, cubes, base ten blocks and other suitable objects available.

Talk briefly about how **area** differs from perimeter as students would have already explored perimeter concepts prior to grade 4. Review, with students, which unit is usually used to measure the perimeter of 2-D shapes. Ask if these units would be useful in measuring the **area (or amount of surface covered)** of 2-D shapes. As students explore area concepts, **reinforce the importance of naming the measurement unit** each time a measurement is said because the units communicate how big the measurement is. Without the unit name, there is no way of knowing what the numbers mean. **It is also important that students learn that the units used to measure the area of an object (or to compare the areas of two objects) must be the same size.**

Length is one-dimensional measurement whereas area describes how many units (square units) are required to measure 2-dimensional surfaces. Sometimes square units refer to the space inside a region (inside the perimeter) such as the area of a field. Other times, square units measure how much it takes to cover a region, as in the number of tiles needed to cover a floor. Area is most often expressed in square units, such as square centimeters (cm^2) and square meters (m^2).

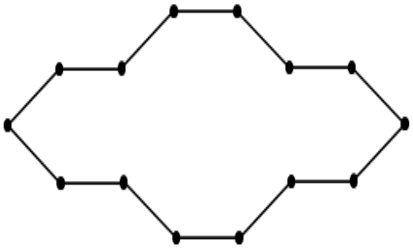
Area measurements are often thought of as being "flat" and at this time, students will mainly investigate area of flat surfaces. Be aware, however, that there are instances in our environment where this might not necessarily be the case (e.g. farm acreage or a golf course which might include hills).

General Outcome: Use Direct or Indirect Measurement to Solve Problems

Suggested Assessment Strategies

Performance
Using Circles, Squares and Triangles to Measure Area
Cut out congruent shapes of circles, squares and equilateral triangles. Provide the students with packages of each shape as well as rectangular mat to measure the area. Have the students use the different shapes to measure the area of the mat and discuss the advantages and/or disadvantages of using each shape. (3.1/3.2)

Performance
Give students a shape made by tracing four yellow hexagon pattern blocks:



Have students measure the shape using yellow pattern blocks, then try to cover the shape again using a different pattern block. Repeat with other pattern blocks. Ask students to record the areas according to the type of unit used to measure. E.g.
"I used 8 trapezoid units"

(3.1)

Resources/Notes

Lesson 6
Measuring with Area Units
SS3 (3.1/ 3.2)
TR pp.36-39
SB pp.283-284

Be sure to include questions #5 and #6 on page on page 284 since they are important questions to consider.

Sources:
Teaching Student-Centered Mathematics K-3, Van de Walle and Lovin, 2006, pp.234-238

Making Math Meaningful to Canadien Students K-8, Marion Small, 2002008, pp. 388 - 411

Strand: Shape and Space (Measurement)

Specific Outcome

It is expected that students will:
4SS3 Continued

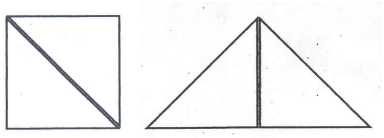
4SS3.2 Identify and explain why the square is the most efficient unit for measuring area.

Suggestions for Teaching and Learning

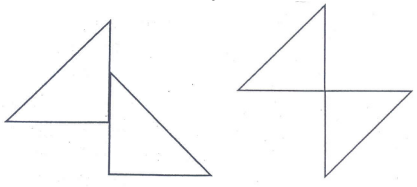
During introductory work, students can explore measuring area with different types of non-standard units and then transition into using standard units to measure area. To help students identify the square as the most efficient unit for measuring area, have them measure a rectangle (such as a book cover) using pennies that obviously do not 'tile' or fit tightly together. When using units such as pennies, students will see that there are spaces not covered and are therefore not counted in the measurement. Consequently they end up with an inaccurate measurement. Students will come to understand that any object that fills a space *can* be used, but squares are most commonly used because they fit together on any side and because they make rows which are easy to count. It is important to point out, however that any units, that fit together with no spaces in between and are not overlapping, can also be used.

Use Children's literature such as *A Cloak for the Dreamer* by Aileen Friedman to reinforce this concept. Provide bristol board templates of various shapes (big square, small square, big triangle, small triangle, hexagon, rectangle, circle) and construction paper in different colors. After reading the book, explain that students have been asked to create a cloak and can illustrate their design on 12 x 18 white paper. After deciding on **ONE** shape to be used in the design (a variety of colors may be used) for the 12 x 18 cloak, students should trace and cut out the pieces to cover the cloak. Students are to arrange the pieces so that the sides of the same length match.

These are okay:



These are not okay:

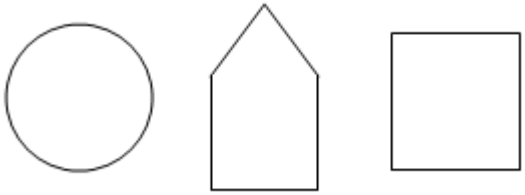


(Continued)

General Outcome: Use Direct or Indirect Measurement to Solve Problems

Suggested Assessment Strategies

Journal:
Show students a rectangular placemat and 3 different shapes of approximately the same area:



Students may explore measuring using a cut out of these shapes until they come to a conclusion about which shape was the most efficient for measuring. Ask which they would choose to measure the area of a placemat and explain why.

(3.2)

Performance:
Iteration (repeating) with Pattern Blocks - Provide the students with rectangular papers that each measure 10 cm by 13 cm. Have them estimate how many copies of each shape of pattern block it would take to cover the rectangle. Then have the students measure the area using each of the shapes in turn.

(3.1/3.2)

Performance
Show students a variety of surfaces which have been partially covered with smaller units. Example: Teacher's desk covered with 3 or 4 adjoining math texts. Estimate and measure other items around the room.

Surface	Estimate
Shelf	*50 sticky notes*

Resources/Notes

Lesson 6 (cont'd)
Measuring with Area Units
SS3 (3.1/ 3.2)
TR pp.36-39
SB pp.283-284

Be sure to include questions #5 and #6 on page on page 284 since they are important questions to consider.

Strand: Shape and Space (Measurement)

Specific Outcome	Suggestions for Teaching and Learning
It is expected that students will: **4SS3 Continued** *4SS3.2 Identify and explain why the square is the most efficient unit for measuring area.*	(Cloak for the Dreamer task continued) Suggest that they explore different arrangements before gluing them onto the paper. The shapes must touch each other without overlapping or leaving spaces in between. We want the Archduke to be really warm without holes in his cloak! Students will present their cloak designs to their classmates upon completion and tell the measurement of the area and tell which unit they used to make and measure the cloak. By allowing students to make choices of which unit to use to measure an area, they are also afforded the opportunity to explore area concepts. Some students will use squares and others may select circles. As the discussion evolves take opportunities to discuss and compare the effectiveness of each area unit. Ask: • Which area unit gives a more accurate measure? • Which area unit is easier to count? • Why would leaving gaps not give an accurate measurement? (all spaces are not covered) • Why would overlapping not give an accurate measurement? Some spaces are counted twice) Following this activity elicit student responses as to why squares are the most efficient unit for measuring. Answers might include: • "squares do not leave gaps" • "you can count squares by rows" • "squares fit no matter which way to turn them" As students begin to find areas they will often have available multiple copies of the measuring tool, for example cubes or square tiles. However, some may want to **iterate** (move one tile from one location to another) if there are not enough square tiles available. Provide modeling clay for students to roll out to form a rectangle of any size. Give them one interlocking cube and instruct them to use it to find the area of their rectangle. Beginning iteration this way makes it easier for students to keep track of the iterations and total number of units. Although the area formula (length x width) is not expected at this grade level, student will eventually use their knowledge of multiplication to make iterating easier. If you prefer you may have students use a stamp pad to complete the same task.

General Outcome: Use Direct or Indirect Measurement to Solve Problems

Suggested Assessment Strategies

Performance
Provide paper and scissors. Have the students make a nonstandard unit for area that they could use to measure their desktop. Remind them that the desk must be completely covered with the unit they choose and that they must repeat their unit at least four times to measure the area of their desk. They should be ready to justify their choice of unit.

Performance
Provide the students with square units to measure their desks or measure congruent mats. Give some groups large squares and other groups small squares. Compare the answers for the areas found. Generalize: to compare areas, the same size unit of measure must be used; i.e., either small squares or large squares. Review the fact that the smaller the unit used to measure area the more of these units are needed. (Adapted from Alberta Education, *Diagnostic Mathematics Program, Elementary: Measurement, Division II* (Edmonton, AB: Alberta Education, 1990), pp. 142–143.)

Resources/Notes

Lesson 6 (cont'd)
Measuring with Area Units
SS3 (3.1/ 3.2)
TR pp.36-39
SB pp.283-284

Be sure to include questions #5 and #6 on page on page 284 since they are important questions to consider.

Curious Math
Pattern-Block Areas
TR p. 40

Strand: Shape and Space (Measurement)

Specific Outcome

It is expected that students will:

4SS3 Continued

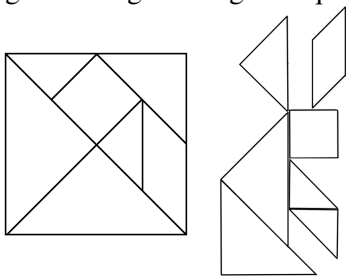
Achievement Indicators:

4SS3.8 Determine the area of an irregular 2-D shape, and explain the strategy.

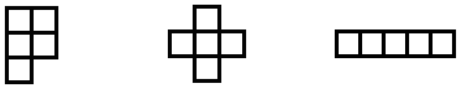
Suggestions for Teaching and Learning

It is essential to provide students with opportunities to measure irregular shapes, since the real-life applications of area measurement apply to all 2-dimensional shapes or regions, not just rectangular ones. The measurement of irregular 2 dimensional shapes can be explored in the following ways:

- students drawings on grid paper
- transparent grid overlays - Opportunities should be provided for students to estimate and calculate the area of various surfaces. Laying an acetate centimetre grid over objects is helpful when determining the area of a surface.
- students might investigate the area of shapes drawn on centimetre dot paper. Strategies for doing this include adding squares and half squares within the figure; placing a rectangle around the shape, determining its area, and subtracting the area of the "extra" pieces
- using geoboards
- cut and reassemble – students can be said to have ‘conservation of area if, when shapes are cut and rearranged they realize that the same amount of space is covered. Provide tangram sets to pairs or individual students. Have students assemble the tangram shapes into a square. Ask: Do all the tangram squares have the same area measurement? Next, students are instructed to reassemble the tangram pieces into a design of their own choosing, using all pieces. Ask: Does you design have the same area measurement as the square you started with? Discuss with students how we might determine whether all of their designs had the same area or not. (Reassemble design into original tangram square)



Pentominoes may also be used to illustrate this concept. Pentominoes are shapes each made up of 5 squares, all of which must have at least one side matching up with a side of another.



area = 5 square units area = 5 square units area = 5 square units

Comparison activities should be designed to help students discover that it is necessary to apply the same unit of measure when comparing 2 different areas. A common misconception is for students to rely on number alone, without considering the size of the units.

General Outcome: Use Direct or Indirect Measurement to Solve Problems

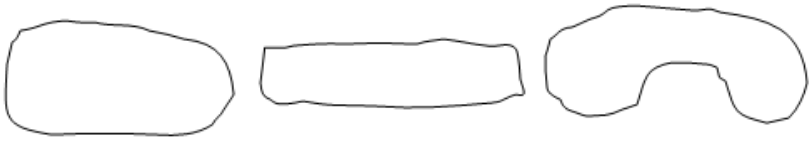
Suggested Assessment Strategies

Performance
Provide students with square grid paper. Instruct them to make a quilt design, using 3 colours, that covers an area of 200 square units. Find the area of each colour.
Ask: How does the area of each colour compare to the total area of the design?
e.g. green – 125 square units
yellow – 50 square units
blue – 25 square units
200 square units

Performance
Use triangles to create and display a simple design on the overhead projector. [Note: The triangles used in the design should be able to form a square when reassembled.] Ask students to determine the area of the design in square units and record the answer. Invite a student to come to the overhead projector and reassemble the design squares before counting the square units. Students compare the answer found to their own answer. Repeat with different numbers of triangles and/or squares. (3.8)

Performance
Provide each group of students with a copy of three shapes, such as the following, that could represent different garden plots. Have lima beans, tiles, buttons, pattern blocks and grid paper available for the students to use. Present the following problem:

Mr. McGregor wants the largest possible garden plot to plant his carrots. He knows that he has to share some of them with the rabbits. Which garden plot should he choose? Estimate first, and then find the area of each garden plot. Explain your thinking.
Examples:



- Have the students explore different ways to find the area of the garden plots, such as covering the surface with objects such as lima beans or tiles, a grid and counting the squares, and drawing a grid on the paper. Ask the students to share the different ways that they might find the area of the garden plots. Then have them choose a method to solve the problem.

Have the students share their answers to the problem and discuss which method they think is the most accurate in finding the areas.

Resources/Notes

Lesson 7
Counting Square Units
SS3 (3.1/ 3.8)
SB p. 286-288
TR p. 41-44

Be selective when choosing tasks in the resource.

Math Game:
Area Logic

SB p. 289
TR p. 45

Strand: Shape and Space (Measurement)

Specific Outcome	Suggestions for Teaching and Learning
It is expected that students will:	
4SS3 Continued	Review the linear units (centimetre and metre) used to find the perimeter of 2-D shapes. Explain that these standard units of measure were used to find perimeter so that the perimeters of shapes could be compared and communicated clearly. Connect the need for standard units in finding perimeter to the need for standard units in finding area. Remind students that measuring with different units makes a difference to the answer. This is a good lead-in to why we use standard units. Rather than measuring with non-standard units, which can mean different things to different people, we use standard units that everyone can understand. The first standard unit students encounter is the **square centimeter.** A square centimeter is an area equivalent to the area of a square with a side length of 1 cm. (Small 2008. Write the symbols and explain that 1 cm^2 is read as "one square centimetre," **not** "one centimetre squared." Note: One square centimetre is a measure for the area of a variety of shapes, whereas one centimetre squared is a square that is 1 cm on each side.
4SS3.3 Provide a referent for a square centimetre, and explain the choice.	Ask students to carefully trace one face of a Base 10 unit cube. Ask: What are the side lengths of the resulting square? [Answer: 1 cm] Ask: How can we tell how much space lies inside the square? [They might respond with "1 cm of space"] Their responses will give clues to misconceptions. Use their responses to elicit the idea that the **area** inside the square is represented as 1 cm^2.
4SS3.6 Estimate the area of a given 2-D shape, using personal referents.	**Referents** are familiar objects that students can refer to, or visualize, to help them have a strong understanding of a unit of measurement. Review the referents used for centimetre (the width of the pinky finger). Ask the students to suggest a suitable referent for 1 cm^2 and explain why they think it would work. Have the students use their referent for 1 cm^2 to estimate the area of a book cover in square centimetres. Then, have them check their estimate by finding the area of the book cover by overlaying a transparency of a centimetre grid. Follow up: Ask what objects around their desks/classroom might we use the standard unit of 1 cm^2 to estimate the area of? Would you try to measure the area of the floor using your personal referent (pinkie fingernail? Why or why not? The following are discussion starters: - Using your referent, estimate the area of a napkin/desk top/door/white board, exercise, etc. Explain your strategy. How many fingernails could cover a crayon box?

General Outcome: Use Direct or Indirect Measurement to Solve Problems

Suggested Assessment Strategies

Performance
HIDE THAT STAIN! Present class with a pair of old jeans or t-shirt that has an obvious stain on it. Have students estimate the area of a patch that would cover the stain. Next, instruct students to cut a patch from centimeter grid paper to match their estimate. Have students check the effectiveness of their "patch" by using it to cover the stain.

Ask: What is the area of the smallest patch that might be used to cover the stain? Are there any patches of different shapes with the same area? How could we order our patches according to their area measurement? (3.6)

Performance
Ask students to estimate how many math texts [units] would be needed to measure the area of the desk surface. Ask: What might the area of the desktop be if 5" x 7" file cards were the unit of measure? How would the area measure change if we used a sheet of Bristol board to measure?
Next, distribute 5 sticky notes to pairs of students. Have them chart estimates for area measurements of different objects found through the classroom using sticky notes as the unit of measure.
Pair share estimates and discuss reasons for similarities or differences. Variation – some pairs of students can use sticky tabs twice or four times bigger than other pairs.

Performance
Provide the students with centicubes or the units of the base ten materials and explain that the area of one face is 1 cm^2. Also, provide them with centimetre grid paper on which they may place the centicubes or base ten units. Have the students use their centimetre rulers to measure the side of each square on the centimetre grid paper to verify that each square is 1 cm^2.

Resources/Notes

Lesson 8
Using Square Centimeters
SS3 (3.1/ 3.3/ 3.6/ 3.7/ 3.8)
SB p. 290-293
TR p. 46-49

Strand: Shape and Space (Measurement)

Specific Outcome

It is expected that students will:

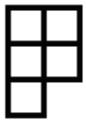
4SS3 Continued

4SS3.7 Determine the area of a regular 2-D shape, and explain the strategy.

4SS3.8 Determine the area of an irregular 2-D shape, and explain the strategy.

Suggestions for Teaching and Learning

Small (2009) suggests a sequence for the introduction of square centimetres. First, the faces of centimetre cubes (from Base 10 materials) can be used as models. Then, centimetre grid paper and transparent centimetre grids can be used to illustrate square centimetres pictorially. Both grids and cubes are good transition tools from non-standard units because they can also be used to cover and count, even before they are recognized as standard units. It is important that students realize that the squares can be cut and rearranged to form many different shapes. Ask students to make as many different shapes as they can with 5 cm². Show them to the class to help students see that although they all have an area of 5 square units, they look different. E.g.



area = 5 square units

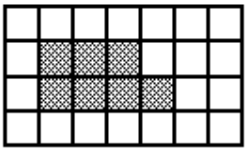
area = 5 square units

area = 5 square units

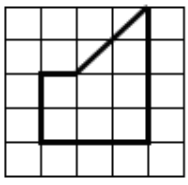
When recording and reporting area measurements in standard units, students need to realize that it is important to state the square unit of measure, usually square centimeters (or square metres). It is recommended that **the use of words precede the use of abbreviated form** in order to facilitate conceptual understanding. Students will be comfortable, eventually, with the understanding that an area measuring 14 square centimetres can be written as 14 cm^2.

Provide students with multiple opportunities to determine area of a surface. It is important to have students estimate first and then choose a method to calculate the area of different surfaces.

Provide students with shapes drawn on grid paper, transparent grid paper and shapes (both regular and irregular shapes) to determine the area. E.g.



Area = 7 squares (7cm²)



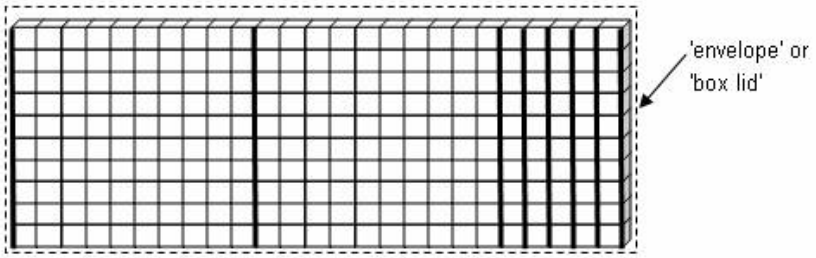
Area= 7 full squares + 2 more halves which is 8 squares (8 cm²)

General Outcome: Use Direct or Indirect Measurement to Solve Problems

Suggested Assessment Strategies

Performance

Provide envelopes or box lids (e.g. shoebox lids) of varying sizes. Ask students to use base ten blocks to measure the area of each. E.g.



"I used 2 hundred centimeters and 40 centimeters to cover the entire envelope, so the area is about 240 square centimeters."

Performance

Provide students with pairs of paper rectangles, such as the following:

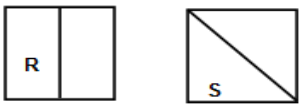
First pair: 1 cm by 9 cm, 3 cm by 6 cm

Second pair: 1 cm by 10 cm, 3 cm by 5 cm

Provide the students with scissors, transparent centimeter grid paper overlays, squares that are each 1 cm^2 and centimeter rulers. Have the students decide which rectangle in each pair has the greater area and explain their thinking. Encourage the students to share their ideas and critique which strategy, for finding area, works best for them. (3.7)

Performance

Provide congruent shapes such as the following. Decide if Part R has the same area as Part S. Explain your thinking.



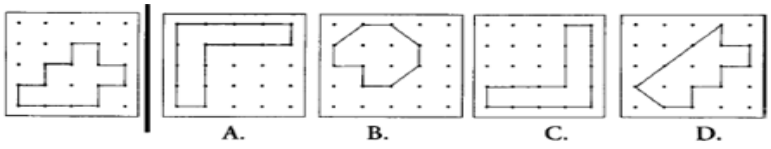
(3.8)

Performance

Make the design below on an overhead geoboard and ask a student to explain to the class how to find the area. Have the students alter the shape on their geoboards to increase the area by 1 cm^2.

Performance

Ask students to circle the letters of the shapes that have the same area as the one on the left:



Resources/Notes

Lesson 8 (Cont'd)
Using Square Centimeters
SS3 (3.1/ 3.3/ 3.6/ 3.7/ 3.8)
SB p. 290-293
TR p. 46-49

Strand: Shape and Space (Measurement)

Specific Outcome

It is expected that students will:

4SS3 (Continued)

4SS3.4 Provide a referent for a square metre, and explain the choice.

Suggestions for Teaching and Learning

Review the referents used for metre (the distance from the teacher's finger tip to his or her opposite shoulder). Ask the students to suggest a suitable referent for one square metre and explain why they think it would work.
Discuss possible referents for one square metre after the students make a square on the floor that is one square metre, using masking tape or other suitable materials. Have the students use their referents and estimate the area of a large tabletop or a section of the classroom floor. Use a square piece of paper that is 1 m by 1m to measure the area and check the estimates.
The ability to visualize standard units in different configurations is useful when estimating area of some objects. For instance, the area of the surface of a shelf or long, narrow countertop would take a long time to estimate in square centimetres. Square metres would give a faster estimate, but the student would first need to understand that an area of 1 m^2 can take on different shapes.

Ask students to use their arms to show you how much area a square metre would cover. Hold up a metre stick and ask how this measuring tool might help us determine a more precise representation. Make 4 metre sticks available and guide students to the discovery that the area inside a square with 1 metre sides represents the standard unit called 1 m^2.

Provide students with a metre stick, newspaper, gift wrap or paper; scissors and tape. Ask them to make a model of a square metre. This model can be now used as a referent to measure larger surfaces. Display it in the classroom for several days during your focus on measurement.

Ask: How can we find the area of our whiteboard? Discuss if it would be a good idea to find the area using square centimeters and students should conclude that this activity would not be practical since it would take a very long time to find an answer.

To extend on students' understanding that the area of a square metre can take on different shapes, provide groups with a pre-cut newsprint square measuring 1 m^2.
Pose problem: What would a triangle with an area of 1 m^2 look like? How many rectangles can you make with an area of 1 m^2? What irregular shapes have an area of 1 m^2? Have students cut and reassemble shapes with tape.

General Outcome: Use Direct or Indirect Measurement to Solve Problems

Suggested Assessment Strategies

Performance
Playground Makeover. Distribute paper grids to represent the area of an abandoned lot. Each square on the grid represents 1 m^2. Tell the students that their job is to draw the plans that will be used to turn the lot into a functional and pleasant play area for children.
Each plan must include:
- a 16 m^2 sandbox
- a 100 m^2 grassy field
- a 16 m^2 rectangular flower bed
- a 8 m^2 area for every swing set
- three 2 m^2 picnic tables

Instruct students to draw or cut and paste the features onto the grid paper in a way they feel is most pleasing. Label each feature.

Resources/Notes

Lesson 9
Using Square Meters
SS3 (3.1/ 3.4/ 3.5/ 3.6/ 3.7/ 3.8)
SB p. 294-295
TR p. 50-52

Strand: Shape and Space (Measurement)

Specific Outcome

It is expected that students will:

4SS3 Continued

Achievement Indicators:

4SS3.6 Estimate the area of a given 2-D shape, using personal referents

Suggestions for Teaching and Learning

Allow students to work in pairs to find the area. Students are likely to come up with differing answers for the same region. Discuss why groups might have different answers and avoid saying there is one 'right' answer. Students should share their strategies so others are exposed to many different strategies.

Personal referents help students to estimate. The various techniques are useful for estimating area:

- referents – use a referent for the single unit of measure and iterate to obtain the estimate; e.g., use the size of the fingernail on your small finger as a referent for 1 cm^2
- chunking – estimate the area of a smaller portion of a shape initially and use this estimate to estimate the entire area of the shape; e.g., estimate the area of the smaller section of the floor and then multiply that answer by the number of these sections in the entire floor.

Have students use their referents to estimate the area of a napkin, a desktop, a door, a white board, an exercise book, etc. Explain their strategy. Next challenge students to find out how many fingernails would cover a crayon box?

Once students have developed personal referents for standard units to measure area, they need ongoing opportunities to apply their understanding to problem solving situations. It is important to allow enough time for students to share solutions. Ensuing discussion will likely provoke thinking as to how shapes with the same perimeter can have different areas.

Students will benefit from sharing strategies with one another. Talking about thinking serves to clarify thought for the speaker and it is also in this setting that students sometimes discover their own misconceptions. Listeners benefit from hearing the ideas of others because they get to see other approaches and strategies besides their own. Listening to the thoughts of others may elicit new ideas or questions in the group.

General Outcome: Use Direct or Indirect Measurement to Solve Problems.

Suggested Assessment Strategies

Performance
Using newspaper, have students make area models for one square metre. These should be used to explore the area of larger regions in the activities below:

Performance
Gymnasium Math - Ask students to choose a personal referent to estimate the area inside a hula-hoop. Is it greater, less or about the same as 1 m^2?
Divide the class in half. Ask each group to come to a concession as to the approximate area of half of the gymnasium. Students elect someone from their team to record predictions and someone to explain their estimation strategy to the class. Following sharing, have teams each measure the area of one half of the gymnasium using their newsprint models. Record results and compare with predictions. Both groups will come together to share findings. Were the results similar? Should they be?

Performance
Divide class into pairs. Supply pairs with sheets of newsprint, tape and scissors. Ask them to make a rectangle that is 2 $m^2$and to explain their strategy to the group. As students to generate a list of objects that might represent a given measurement such as 1 m^2. As each student contributes to the list, he/she should explain why they think their contribution is reasonable.

Performance
Divide class into groups. Distribute to each group: 6 m^2 lengths of string, old newspapers, scissors, tape and student made 1 m^2models prepared in previous activity. Pose this problem:
Imagine that some milk has spilled from a 2L container. Instruct students to tie the string together at both ends and next to form the loop of string into an irregular shape on the floor. Say: The shape inside the string represents how much milk has been spilled. Can you find the area of spilled milk?

Resources/Notes

Lesson 10
Estimating Areas
SS3 (3.4/ 3.6/ 3.8)
SB p. 296
TR p. 53-55

[Additional practice may be required]

Curious Math (optional)
SB p. 297
TR p. 56

This is a good activity if time permits.

Strand: Shape and Space (Measurement)

Specific Outcome

It is expected that students will:

4SS3 Continued

4SS3.9 Construct a rectangle for a given area.

4SS3.10 Demonstrate that many rectangles are possible for a given area by drawing at least two different rectangles for the same given area.

Suggestions for Teaching and Learning

Provide opportunities for students to explore different strategies to accomplish the following task:
Examples: Give groups of students a select number of tiles to construct different rectangles and then compare and discuss results. Some students might relate this activity to the construction of arrays used to represent multiplication number sentences. [See also N 6]

- Students can use geoboards to construct rectangles of a given area.

Objects of different shapes can have the same area. Figures A & B have the same area even though the perimeter of A is greater.

Figure A Figure B

Students may not realize that an area which is rearranged into different shapes will still have the same area measurement as the original shape.
Provide students with geopaper or squared dot paper to draw or construct rectangles. Ask: How many rectangles can you find with an area of 12 square units. Examine student work to find all of the possibilities. Cut and paste a sample of each type of rectangle to a coloured background to display on bulletin board.

Note that some students, through their exploration of tiling and arrays, might discover the multiplication formula for finding area on their own, even though this would not be an expectation at this level.

Ask students how we would know if we've come up with all the possibilities for rectangles with an area of 12 cm^2? This may be an opportune time to discuss how organized lists can help us to keep track of information.

General Outcome: Use Direct or Indirect Measurement to Solve Problems

Suggested Assessment Strategies

Performance
Have students use colour tiles or grid paper to investigate the numbers from 1 to 30 to see how many different rectangles can be made for each. Students should record their results and look for patterns. (3.10)

Performance
Invite the students to select 16 pieces of the same pattern block (the blue rhombus, for example). Using the rule that at least one side must match up exactly with one side of another block, have them make different shapes, all of which have an area of 16 units. Ask them to find, among others, the most compact shape and the longest shape (3.10)

Performance
Provide the students with tiles and centimetre grid paper. Give them the following instructions: For each of the areas from 1 cm^2 to 20 cm^2, find all the possible rectangular arrays using whole numbers. For example, the possible arrays for an area of 6 cm^2 would be as follows:

(3.10)

Performance
Divide class into groups of 4. Each student is given tiles and grid paper. Student A creates a rectangle on grid paper which the others cannot see, and records the area in cm^2. Students B, C, and D are asked to create a rectangle of the same area. The team then analyzes the various responses. Ask: What do your responses tell us about area? Can you make any connections or see any patterns that relate to the area of rectangles? (3.9)

Resources/Notes

Lesson 11:
Solving Problems using Organized Lists

SB p. 298-299
TR p. 57-59

Strand: Shape and Space (Measurement)

Specific Outcome

It is expected that students will:

4SS3 Continued

4SS3.9 Construct a rectangle for a given area.

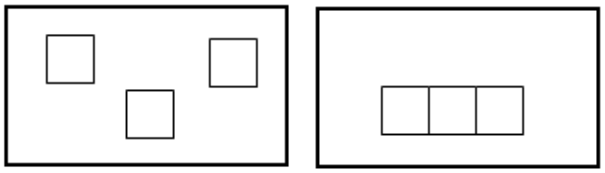
4SS3.10 Demonstrate that many rectangles are possible for a given area by drawing at least two different rectangles for the same given area.

Suggestions for Teaching and Learning

.

Present the following scenario to the students: Grandma is making a quilt with three patches of blue cloth on a white background. She needs help deciding where to put the patches. If grandma wants the patches to cover the same amount of space on the white background, should she scatter them about or put them together in a group? Explain your answer.

Provide the students with three pieces of blue paper to represent the patches of blue cloth. Ask them to move the papers around on their desk, which can be the white background for the quilt, and decide which arrangement would be best for the quilt. If necessary, provide scaffolding by moving three pieces of paper on the overhead projector into different positions. Example:



Through discussion, have the students verbalize that grandma can put her three patches of blue cloth anywhere on the white background and they will always cover the same amount of surface.

Changing Shapes - Provide each student with at least four congruent squares each of a different colour. Have the students compare the squares by superimposing one on the other to show that they are congruent – same size and shape. Reaffirm that these squares each cover the same amount of surface or have the same area.

Have the students cut one of their squares along the diagonal to make two triangles. Instruct them to rearrange the two triangles to make as many different shapes as possible with two sides aligned.

Encourage the students to make other designs by cutting a square in different ways and rearranging the pieces. Reinforce that the pieces of one square must be rearranged to make one design – the pieces are the same colour. The students may glue their designs on newspaper and place them into groups on the floor, justifying the categories. Ask the students to describe the differences and similarities among the designs. Guide the discussions to generalize that all designs cover the same amount of surface or have the same area.

General Outcome: Use Direct or Indirect Measurement to Solve Problems

Suggested Assessment Strategies

Performance

Sammy wants a dog pen for his dog. He wants the pen to have an area of 32 m^2.

Draw all the possible rectangular pens that have the area of 32 m^2 on centimetre grid paper. The sides of the rectangles must be measured in whole numbers.

Explain how you know that you have drawn all the possible rectangular pens. Which pen would you advise Sammy to use? Explain why. (3.10)

Pencil Paper

Provide the students with a template for the Frayer Model and have them fill in the sections individually or as a group to consolidate their understanding of area.

A sample of a Frayer Model is provided below:

Definition

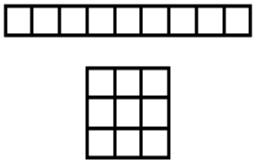
Area is the measure of the space inside a region.

Characteristics

- the area of a region remains the same when the region is rearranged
- area can be measured in nonstandard or standard units for area
- the smaller the unit of measure the greater the number of units needed to measure a given area
- when comparing areas, the same units must be used
- standard units for area include cm^2 and m^2
- for a given area, there are usually many different rectangles that can be drawn

Real-life Problem and Visual Representations

Cindy wants a rectangular flowerbed that is 9 m^2. What are the different flowerbeds that she could have if the lengths and widths are whole numbers?



Cindy could have 2 different flowerbeds – one that is 1 m by 9 m and the other that is 3 m by 3 m.

Area

Examples

Area is used in the following:

- tiling a floor
- seeding lawns
- painting walls
- buying windows
- covering counter tops

Nonexamples

Area is not used in the following:

- fencing around a garden
- lace around a tablecloth
- liquid in a glass
- weight of a person
- cans of pop in a box

Resources/Notes

Lesson 11
Solving Problems Using Organized Lists
SB p. 298-299
TR p. 57-59

Strand: Shape and Space (Measurement)

Specific Outcome	Suggestions for Teaching and Learning
It is expected that students will: **4SS3 Continued**	
4SS3.6 Estimate the area of a given 2-D shape, using personal referents.	As students gain experience with area measurement, they may extend on their base of personal referents. The Base 10 flat, for example, is a handy tool to visualize the surface area covered by 100 cm^2. The largest face of a standard white vinyl eraser may be used as a referent for about 10 cm^2.
4SS3.8 Determine the area of an irregular 2-D shape, and explain the strategy.	Standard unit tools that students may find useful in determining the area of irregular 2-D shapes, such as hand or foot prints, include but are not limited to: • transparent centimetre grid paper that can be used to overlay a shape in order to find the area in square centimeters. Laying an acetate or transparent centimeter grid placed on the top of an object provides a pictorial model for measuring area. It allows students to count the number of units that cover or partially cover the shape. • centimetre grid paper upon which an object is laid and the area to be measured in square centimetres is traced. Area measurement is then determined by counting the squares and part squares. Ask students to estimate and determine the area of familiar objects such as mittens, leaves and fancy cut sticky note sheet. Have student explain their chosen strategies. In measuring irregular shapes there may be lots of units that only partially fit. Students will count full units and can visually put together parts of units to count as one unit. Students may use colored marks to represent whole units and use a different colored mark to represent ½ units. Give students centimeter grid paper and ask them to use centimeters  and half centimeters  to make a design. Have them record the area of their design and pass it to the teacher. Assign a letter to each design and display all designs in an area where students have easy access. This activity can be used in a center, during non-instructional times or when students finish other tasks. Ask students to find the area for each shape, write their answers on paper (e.g. A is 21 square centimeters, B is 45 square centimeters, etc.) and deposit their answer sheet into a nearby box. At the end of the week, reward students for "Measuring up"!

General Outcome: Use Direct or Indirect Measurement to Solve Problems

Suggested Assessment Strategies

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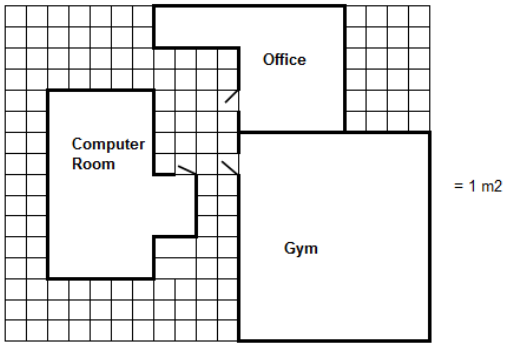
Pencil-Paper
Students use small cardboard boxes to design a house for a small toy figure. Then students write a description of the house in their journal using area estimates or measurements to describe the floor, roof, windows, etc.

Performance
Provide students with equal size pieces of modeling clay. Set a time limit for students to roll out the largest surface area they can make (without holes). Have students choose and explain a strategy to determine the area measurement of their clay "blob".

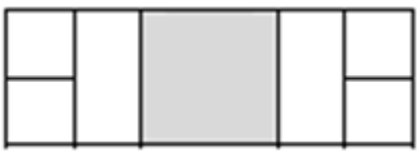
Performance
Have students make paint blotches by dropping a spoonful of paint onto centimetre grid paper. Allow to dry. Choose a method to determine area of blotches and explain procedure used. Post blotches and measurements for comparison purposes.

Performance
Use the partial floor plan for a school as shown below to complete the instructions that follow.



Find the area of the computer room. Explain your thinking.
Find the area of the office. Explain your thinking.

Performance
The area of the entire design below is 12 m^2. Find the area of the shaded part.



Resources/Notes

Lesson 12
Estimating Areas on Grids
SB p. 300-301
TR p. 60-62

Chapter Task
Making a Photo Display
TR pp. 68-69
SB p. 305

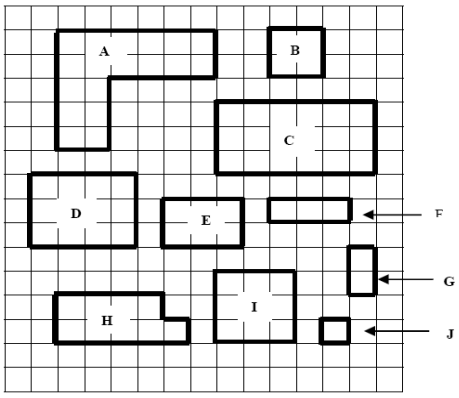
Strand: Shape and Space (Measurement)

Specific Outcome	Suggestions for Teaching and Learning
It is expected that students will: **4SS3 Continued**	
4SS3.6 Estimate the area of a given 2-D shape, using personal referents.	Have students work in pairs to trace around odd shaped items, for example their own hand with fingers together, a leaf, etc. Next, cut the shapes out. Students then estimate the area of each shape. After finding the approximate area of each shape, have students place the items in order from least to greatest. Pick some students to present their findings and describe their strategy for finding the area, to the rest of the class.
4SS3.8 Determine the area of an irregular 2-D shape, and explain the strategy.	

General Outcome: Use Direct or Indirect Measurement to Solve Problems

Suggested Assessment Strategies

The Lake and Island Board uses one square centimetre as the basic unit for measuring area. Provide the student with copies of the Lake and Island Board shown below without the centimetre grid. Make a transparency of the board without the centimetre grid to use for discussion with the whole class.



Present the students with a set of problems, such as the following:
• Suppose you and your family are moving to Lake and Island Country. You wish to purchase the largest island available so that there is plenty of room for the family. Which island would you purchase? Estimate first and then find the areas of the islands to determine your answer. Do you have a choice? If so, what would be the advantages and disadvantages of either choice?
• Some friends of yours, the Jones, also wish to purchase an island. They want one that is only one-third as large as yours. Which island would you suggest that they buy? Do they have a choice? If so, what is it?
• As time goes by, members of your family grow up. Two of the grown children, Lauren and Kevin, each wish to buy an island the same size. Which two islands would you suggest they purchase? Estimate first and then find the areas to determine your answer.
• A plant disease epidemic breaks out and all the islands have to be sprayed. What is the total area of all the islands?
• The Jones' family wants to double the amount of land they now own. Which set of islands could they buy to satisfy this need?
• Name a pair of islands in which the area of one island is three times the area of the other island.
• Name a pair of islands in which the area of one island is double the area of the other island.
• Draw as many different rectangular islands with whole number dimensions that are the same area as Island D. Explain your thinking.

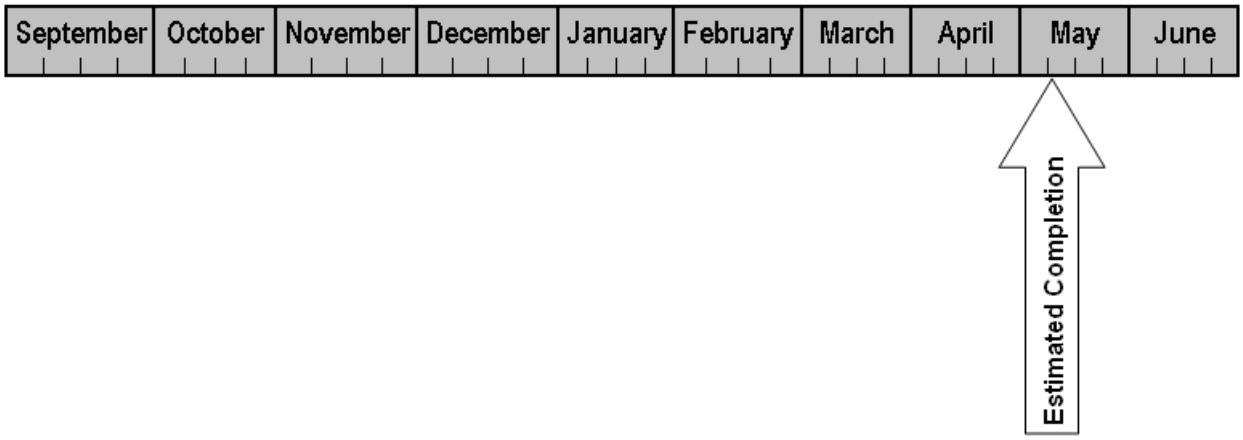
(3.10)

Resources/Notes

Lesson 12
Estimating Areas on Grids
SB p. 300-301
TR p. 60-62

Chapter Task
Making a Photo Display
TR pp. 68-69
SB p. 305

Unit 9
MULTIPLYING MULTI-DIGIT NUMBERS
Suggested Time: approx 3-4 weeks



Unit Overview

Big Idea

This unit is a continuation of unit 6. In this unit, students will review strategies that learned early and now apply them to multiply two and three digit numbers. Students will experience greater success with applying these strategies to larger numbers if they can automatically recall the multiplication facts. The outcomes addressed in this unit prepares students for multiplication of two-digit by two-digit numbers which will be studied in Grade 5.

Process Standards Key

[C] Communication
[CN] Connections
[ME] Mental Mathematics and Estimation
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

Strand: Number

Specific Outcome

It is expected that students will:

4N5 Describe and apply mental mathematics strategies, such as:

- **skip counting from a known fact**
- **using doubling or halving**
- **using doubling or halving and adding or subtracting one more group**
- **using patterns in the 9s facts**
- **using repeated doubling to determine basic multiplication facts to 9 × 9 and related division facts. [C, CN, ME, R]**

4N6. Demonstrate an understanding of multiplication (2 or 3-digit by 1-digit) to solve problems by:

- **using personal strategies for multiplication with and without concrete materials**
- **using arrays to represent multiplication**
- **connecting concrete representations to symbolic representations**
- **estimating products**
- **applying the distributive property. (Cont'd) [C, CN, ME, PS, R, V]**

Achievement Indicators:

4N6.4 Refine personal strategies to increase their efficiency.

Suggestions for Teaching and Learning

By solving problems in contexts that relate to the children's own lives, the students use their prior knowledge to make sense out of the problem and then use computational strategies that they are able to explain and justify. The student's understanding of multiplication is enhanced as they develop their own methods and share them with one another, explaining why their strategies work and are efficient to use (Principles and Standards for School Mathematics, 2000, p. 220).

When solving a multiplication problem, work with the whole group initially and have the students paraphrase the problem to enhance understanding (Willis et al. 2006) before they record their process. Provide a variety of materials such as base ten blocks, counters, chart paper and markers.

There are many good reasons why students should be encouraged to use personal and varying strategies for multiplication. Sometimes one strategy or algorithm makes more sense to a student than another one or works better for a particular set of numbers. Sometimes students may get help from a parent who exposes them to a strategy that is different than those he/she learned at school. It is helpful for students to be 'open' to both. Also, strategies that students 'invent' are usually more meaningful because they 'created' it and they are better able to apply them because it 'makes sense' to them. Another benefit of students' hearing varying strategies is that it means a student can use one strategy to solve the computation and another one to check it.

Allow plenty of time for students to explore their own strategies and to develop a range of strategies. This understanding will help students become more efficient and have a better understanding of the traditional algorithm. As children are working using their invented strategies encourage movement towards more efficient strategies.

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Journal Writing/Self Assessment
Book ~ Classroom Assessment Model, P. 72)

Resources/Notes

Lesson 1:
Exploring Multiplication
N5
N6 (6.7)
SB p. 310
TR p. 13-15

Additional reading:
Big Ideas from Dr. Small
(Small, 2009) pp. 25 - 41

Teaching Student-Centered Mathematics Grades 3-5, (Van de Walle & Lovin, 2006)pp.113-120

Math Game – Twenty-Four
N5
SB p. 311
TB p. 16-17

Strand: Number

Specific Outcome

It is expected that students will:

4N6 Continued

46.7 Solve a given multiplication problem, and record the process.

Suggestions for Teaching and Learning

In problem solving situations where multiplication is involved, you will need to draw on prior knowledge by reviewing multiplication facts. Emphasize the connections among the story problems, the models/diagrams, the number sentences and the personal strategies used in calculations.

Present the students with a problem or a number sentence involving multiplication, such as the following:

- Laura wanted to make beaded bracelets for her friends. She has 6 friends and each bracelet will require 45 beads. How many beads will Laura need to purchase at Michael's craft store?

Have the students divide their page into four sections to make graphic organizers and label them as follows:

Four Corner Strategy

Story Problem	**Models/Diagrams**
Laura wanted to make beaded bracelets for her friends. She has 6 friends and each bracelet will require 45 beads. How many beads will Laura need to purchase at Michael's craft store?	
Number Sentence	**Personal Strategy**

Have the students complete the graphic organizer by writing the story problem or the number sentence in one corner and filling in the other corners appropriately. This will help the students organize their thoughts before recording their process.

Provide the students with a Multiplication problem and then ask them to prepare an infomercial for a fictitious TV show, Math News. They will need to explain their personal strategies for solving the given multiplication problem. Students may use concrete materials or pictures to demonstrate the personal strategies they used to solve the problem. Have students present their infomercial. While the students are presenting their commercial, look for evidence that personal strategies were used, personal strategies were effective and solved the problem accurately and that students included models, illustrations, symbolic representations in their descriptions of personal strategies

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Student/ Teacher Dialogue
Conduct interviews with the students to determine their abilities to use personal strategies when solving given multiplication problems. During the interview record observations about how each student applies personal strategies and also their confidence in solving the problem

Pencil/Paper
Solve the following problems. Record the process:

- Your class is celebrating the end of your Australian unit in Social Studies. If there were 24 people in your class, and each person wanted two Anzac cookies, how many Anzac cookies would you need to make for the celebration? (48) If the Anzac cookie recipe makes 12 cookies, how would you make 48 cookies?
- You have 15 cookies to share equally among 3 children. How many cookies will each child receive?
- Hannah walks her dog for 48 minutes each day. How many minutes does she walk in 3 days?
- Last year you saved $32.00. This year you saved 4 times as much money as last year. How much money did you save this year?
- How many different single-scoop ice cream cones can be made with 4 different kinds of cones and 28 different flavours of ice cream? (N6.7)

Presentation
Have students create a picture book for the class library explaining the personal strategies they used to solve a given multiplication problem. Students could also design a cover for their Math picture book indicating a title, the author and illustrator and share them with other classrooms. When reviewing the book that each student has created, look for evidence that they clearly described the process (in words and pictorially) they used to solve the multiplication problem using their personal strategies.

(N6.7)

Have students assess each other's work by completing a peer assessment sheet, using criteria established as a class such as the following examples:

- The presentation and explanations were clear. I understood what _____ was trying to say.
- Here is what I think _____ said.
- This group used graphic presentations that were clear and had something important to show.
- _____'s strategy of _____ solved the problem correctly.
- This group used appropriate mathematical vocabulary.
- Something that _____ did really well was _____.
- A question I would like to ask _____ about is _____.

Resources/Notes

Lesson 1 (Cont'd)

Strand: Number

Specific Outcome

It is expected that students will:
4N6. Continued

Achievement Indicators:

4N6.2 Use concrete materials, such as base ten blocks or their pictorial representations, to represent multiplication; and record the process symbolically

4N6.6 Model and solve a given multiplication problem, using an array, and record the process.

Suggestions for Teaching and Learning

There is value to exposing students to products involving multiples of 10's and 100's. Students will use this understanding to help them compute multiplication situations.

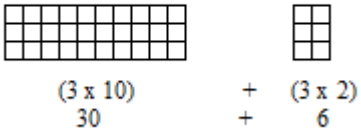
The use of manipulatives or models helps the students to understand the structure of the story problem and also connects the meaning of the problem to the number sentence (Van de Walle, 2001, p. 108). To develop understanding of the meaning of operations, the student needs to connect the story problem to the manipulatives, create a number sentence and then use personal strategies to solve the problem.

Computational strategies for multiplication are more complex and it is important that students think about number meaning and not 'digits'. For multiplication the ability to break numbers apart is important. Give students time to practice breaking apart numbers and to make sense of them. For example

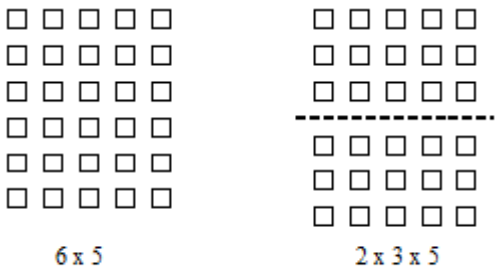
Students can be taught to multiply by breaking up the multiplier.An **array** is a good way to show this. For Example, 3 x 12 can be viewed as 3 x 10 and 3 x 2;

For example:

3 x 12 = 36



You can easily separate 6 rows of 5 squares into 2 groups, each with 3 rows of 5, without changing the total number of squares (Small, Prime, p. 58, 2005).



6 x 5 = 2 x 3 x 5

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Resources/Notes

Lesson 2:
Multiplying 10s and 100s
N6 (6.2/ 6.7)
SB p. 312-313
TB p. 18-21

Lesson 3:
Multiplying Using Arrays

N6 (6.1 / 6.6 / 6.7)
SB p. 314-317
TB p. 22-25

Strand: Number

Specific Outcome

It is expected that students will:
4N6. Continued

4N6.1 Model a given multiplication problem, using the distributive property;
e.g., 8 × 365 = (8 × 300) + (8 × 60) + (8 × 5).

Suggestions for Teaching and Learning

Students can learn that they can multiply in parts i.e. the **Distributive Property.** This property lets you separate numbers into parts so that the numbers are easier to work with.

For Example:
How many weeks are there in 3 years? To solve, you can find the product of 3 and 52. To multiply in your head, you can use the Distributive Property:

3 x 53 = 3 x (50 + 2)
(3 x 50) + (3 x 2)
150 + 6 = 156

There are 156 weeks in 3 years.

The Distributive Property also tells you that you can multiply a difference by multiplying each part separately and then subtracting the products. For Example:
6 x 19 = 6 x (20 – 1)
(6 x 20) – (6 x 1)
120 – 6 = 114

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Student/Teacher Dialogue
Explain why the following solution is correct or not:
6 x 128 = (6 x 100) + (6 x 20) + (6 x 5) = 600 + 12 + 30 = 642

Model the following multiplication problem using the distributive property:

6 x 256 =

(N6.1)

Resources/Notes

Lesson 4:
Multiplying Using Expanded Form

N6 (6.1 / 6.2 / 6.7)

SB p. 318-321
TB p. 26-29

Strand: Number

Specific Outcome

It is expected that students will:
4N6. Continued

4N6.5 Estimate a product, using a personal strategy; e.g., 2 x 243 is close to or a little more than 2 x 200, or close to or a little less than 2 x 250.

Suggestions for Teaching and Learning

Students should be encouraged to use 'reason' when estimating the answer to a computation (Small, Prime, 2005, p. 139). To estimate products, students need to know the multiplication facts and how to multiply with multiples of 10, 100, 1000, and so on.

Ask students if they have lived closer to 300, 3000, or 30 000 days, and then have them explain how they know. For example, one year has 365 days, so it can't be 300 days. Ten years is just a bit less than 10 x 400 days or 4000 days, so 3000 makes the most sense because 30 000 would be much too high.

A number of factors come into play when making decisions about estimating such as the context, and the numbers and operations involved. Students should be aware that estimates which involve multiplication and division with greater values often tend to be further from the actual values than is the case when estimating with addition and subtraction.

To estimate products students might:

- round one or both numbers to the nearest multiply of 10, 100 0r 1000 … for example, 25 x 52 is about 25 x 50 = 1250
- round one factor up and one factor down. For example, 65 x 12 is about 60 x 20 = 1200
- round numbers such that familiar multiplication facts can be used. For example, 4 x 51 (I know 4 x 5 - think 40x 5 =200 + 4 x 1 = 4 so the answer is 204) (Small, 2009)

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Student/Teacher Dialogue
Ben estimated 47 x 7 as 500. Ask the student to explain Ben's thinking, and if he/she would estimate it differently. (N6.5)

Student/Teacher Dialogue
Ask the students to give an estimate for each of the following and explain the strategy they chose.
79 x 6 =
215 x 7 = (N6.5)

Student/Teacher Dialogue
Estimate the following product using a personal strategy:
2 x 243 = (e.g. 2 x 243 is close to or a little more than 2 x 200, or close to or a little less than 2 x 250) (N6.5)

Student/Teacher Dialogue
You travel 375 km each day for 3 days. Will you reach the cabin that is 1200 km away by the end of the third day? Explain. (N6.5)

Journal Writing
Ask students to explain in writing the estimation strategies for each equation below, and to decide which estimation is closer to the actual product.

79 x 9 as 80 x 10 or 80 x 9
17 x 15 as 8 x 30 or 20 x 10

(N6.5)

Resources/Notes

Lesson 5:
Estimating Products

N6 (6.5 / 6.7)

SB p. 322-324
TB p. 30-33

Strand: Number

Specific Outcome

It is expected that students will:
4N6. Continued

4N6.5 Estimate a product, using a personal strategy; e.g., 2 x 243 is close to or a little more than 2 x 200, or close to or a little less than 2 x 250.

46.7 Solve a given multiplication problem, and record the process

Suggestions for Teaching and Learning

Please Note: Students need to be aware that when multiplying, rounding one factor has a different effect than rounding the other. In the following example, rounding the 8 to a 10 has a greater effect on the estimated product than rounding the 68 to a 70, even though it is an increase of 2 for each. This is because two extra 68s in 68 x 10 is more than 8 extra 2s in 70 x 8 (Small, Big Ideas, 2009, p. 34).

Numbers that are easier to work with in estimation are sometimes referred to as "Friendly Numbers". Students should be familiar with this term, so continue to use it when covering this outcome.

Present the students with the following problem:
You have 3 pieces of licorice, each 27 cm long. About how many centimeters of licorice do you have?

Have the students paraphrase the problem. Draw attention to the word about, which indicates that an estimated answer is needed and no calculation has to be done. They may use the Four Corner Strategy (discussed in lesson 1) to help them solve the problem.

Through discussion, have the students verbalize that 3 x 27 is close to or a little more than 3 x 20, or close to or a little less than 3 x 30: however, it is closest to the latter. Explain that you will be use 30 to represent 27 because 30 is closer to 27 than 20. Use the number sentence, 3 x 30 = 90, to show the estimated product.

Stimulate the students' thinking by asking whether 90 cm would be a good estimate for the answer. With the base ten blocks, the students should see readily that the blocks show a number less than 90. Therefore, a good estimate would be 90 – 10 = 80cm. Explain that the 10 is subtracted to compensate for the value that was added on when choosing the nearest multiple of ten and multiplying it by 3.

Estimate: Three licorices would be a little less than 90 cm long or about 80 cm long.

Have the students apply this estimation strategy and any other strategies that make sense to them in solving problems that require the multiplication of a 3-digit number by a 1-digit number. In these examples, the students would take the 3-digit number to the nearest multiple of 100, estimate the product and then compensate their answer appropriately.

When students are encouraged to think and communicate their reasoning to others, they learn to be clear and to make connections. Likewise, as others listen, they themselves, develop their own understandings. Written communication has to be nurtured from pictures to writing words and symbols in grade 4 that should become more elaborate with a sense of giving a sequence and some details to the reader.

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Resources/Notes

Lesson 5 – Estimating Products (Cont'd)

Math Game:
Greatest Product

N6

SB p. 325
TR p. 34-35

Lesson 6:
Communicating About Solving Problems

N6 (6.7)

SB p. 328-329
TR p. 39-42

Strand: Number

Specific Outcome

It is expected that students will:

4N6. Continued

4N6.3 Create and solve a multiplication problem that is limited to 2- or 3-digits by 1-digit.

Suggestions for Teaching and Learning

Students should use a variety of models to investigate multiplication problems to help develop an understanding of the connection between the model and the symbols. It is important to start with a word problem and then have students use materials to determine the product. Base-ten blocks serve as a tool for understanding the multiplication operation. It is important that the students use language as they manipulate the materials and record the corresponding symbols for the product. It is not expected that students would be explicitly taught all possible algorithms, but provide opportunities to discover which is most efficient for the numbers included in a given problem.

After students are comfortable with using base ten blocks when multiplying, they should be encouraged to use the front-end multiplication strategy (multiply showing the number of hundreds first).

Student should have many opportunities to solve and create word problems for the purpose of answering real-life question, preferable choosing topics of interest to them. These opportunities provide students with a chance to practice their computational skills and clarify their mathematical thinking.

The use of manipulatives or models helps the students to understand the structure of the story problem and also connects the meaning of the problem to the number sentence (Van de Walle 2001, p. 108).

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Student-Teacher Dialogue/ Performance
Ask student to solve the following problems using three different strategies - concrete materials (base ten blocks), personal strategies, distributive property, arrays or algorithms:

- Here is $60. Ask, "Do you have enough money to buy 3 CDs if each costs $17? How do you know?"
- For a school assembly, 9 rows of 38 chairs have been placed in the gym. Are there enough chairs for 370 students? Explain your thinking.
- Ask students to create and solve a realistic problem that includes the factors 6 and 329.
- Your family has planned a trip to Florida. You save 6 times as much money this year as you saved last year for your trip. If you saved $125 last year, how much spending money did you save this year? 6 x 125 =

Journal Writing
Have students create a multiplication problem for the equation 260 x 5 and then solve it.

Resources/Notes

Lesson 7:
Multiplying 3-Digit Numbers

N6 (6.1 / 6.2 / 6.3 / 6.5 / 6.7)

SB p. 330-332
TR p. 43-46

Strand: Number

Specific Outcome

It is expected that students will:
4N6 Continued

Suggestions for Teaching and Learning

To develop understanding of the meaning of operations, the students connect the story problem to the manipulatives, create a number sentence and then use personal strategies to solve the problem.

Provide appropriate time for students to create their personal strategies to solve the problem and then challenge them to solve the problem another way. It's important that students understand the multiplication operation and not be taught to simply follow a procedure to obtain a product.

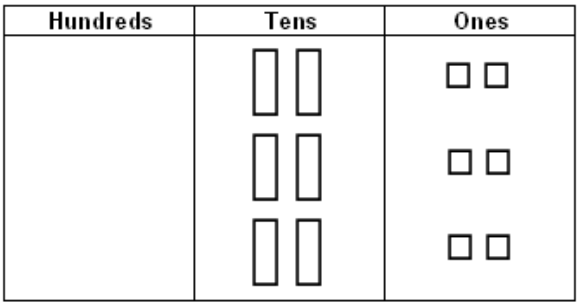
Students need to understand what is given in a multiplication problem and what is the unknown, using the following terms: number of groups, quantity in each group or whole.

Solve the following multiplication problem by estimating first, then modeling the problem using base ten blocks and record using expanded form, then multiply to show the number of hundreds first or by showing the ones place first.

For Example:
You made 22 oatmeal cookies from one batch of mix. You make 3 batches of cookies. How many cookies did you make?
Step 1: Estimate First

3 x 22 is about 3 x 20 = 60 cookies. I predict that I will make a little more than 60 cookies.

Step 2: Use base ten blocks to represent your problem



I'll make 3 groups of 22 with Base ten blocks then I'll record using expanded form.

Step 3: Multiply showing the number of hundreds first or the number of ones first

$$\begin{array}{r} 20 + 2 \\ \times\ 3 \\ \hline 60 \\ +\ \ 6 \\ \hline 66 \end{array} \qquad \begin{array}{r} 20 + 2 \\ \times\ 3 \\ \hline 6 \\ +\ 60 \\ \hline 66 \end{array}$$

Remember to discuss and compare the final product in step 3 with their estimate in step 1.

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Resources/Notes

Lesson 7 Continued)

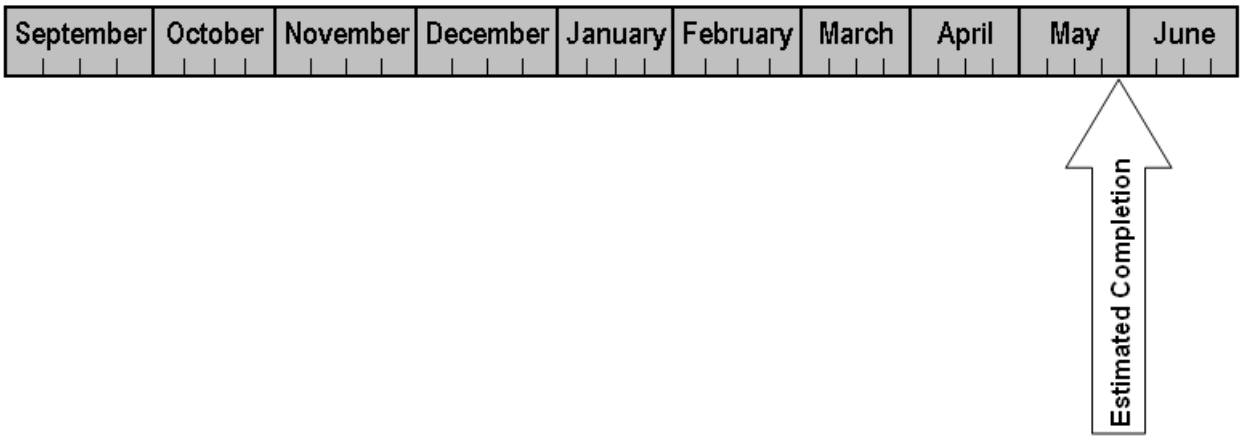
Curious Math:
Egyptian Multiplication Sum and Product
N6 (6.6 / 6.7)
SB p. 333
TR p. 47-48

Lesson 8:
Multiplying Another Way
N6 (6.2 / 6.3 / 6.5 / 6.7)
SB p. 334-337
TR p. 49-52

Lesson 9:
Choosing a Method for Multiplying
N6 (6.2 / 6.5 / 6.7)
SB p. 338-340
TR p. 53-56

Lesson 10:
Creating Multiplication Problems
N6 (6.3 / 6.7)
SB p. 341
TR p. 57-59

Unit 10
DIVIDING MULTI-DIGIT NUMBERS
Suggested Time: approx. 3-3 ½ weeks



Unit Overview

Big Idea

Earlier, in unit 6, students worked with smaller numbers in developing the concept of division. In this unit they continue to develop an understanding of division but with larger whole numbers. Through encounters with various problem situations, students will develop fluency in computing division problems that will be an essential skill to use in real life situations. They will also continue to learn the meaning of division and how it relates to multiplication. Focus is on computational fluency with larger numbers so that students learn efficient and accurate methods of computing. This can be developed by solving problems with larger numbers that require calculation and by recording and sharing their strategies with others. Estimation plays an important role in division because it provides a tool for judging the reasonableness of an answer.

. . . There are two different concepts of division, depending on which factor is unknown . . . . If a quantity is to be separated evenly into a given number of subsets [i.e., fair sharing] then division expresses the number in each subset. . . . If a quantity is to be measured out into sets of a specified size, then the division expresses the number of such sets that can be made [i.e., how many groups]. (Elementary School Mathematics, pp. 124-25)

Process Standards Key

[C] Communication
[CN] Connections
[ME] Mental Mathematics and Estimation
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

Strand: Number

Specific Outcome
It is expected that students will:

4N7 Demonstrate an understanding of division (1-digit divisor and up to 2-digit dividend) to solve problems by:
• using personal strategies for dividing with and without concrete materials
• estimating quotients
• relating division to multiplication
[C, CN, ME, PS, R, V]

Suggestions for Teaching and Learning

4N7.2 Solve a given division problem with a remainder, using arrays or base ten materials, and connect this process to the symbolic representation.

Remainders are new to grade 4 students. Although remainders are not formally introduced until a little later, students may experience situations where there are remainders. You may want to introduce the concept when it arises incidentally. Reference to "left-overs" in given problem CAN be a clue that there will be a remainder in the quotient. In cases where students discover a remainder, they should understand that the remainder must be less than the divisor. The use of models in problem solving situations will help clarify their thinking about this.

4N7.3 Solve a given division problem, using a personal strategy, and record the process.

4N7.4 Refine personal strategies to increase their efficiency.

Refer back to page 159 in curriculum guide for the introduction of this indicator. Additional detail on personal strategies is discussed throughout this unit. Provide time for students to explore strategies to use with division of larger numbers, and to use the one that works best for them. Allow them to invent their own strategies before showing them a strategy you prefer. They should also be able to discuss their strategies with classmates. Teachers could help stimulate reasoning and communicating skills by asking the following questions:

- How did you solve that problem?
- How else could you have solved it?
- What did you like best about your partners strategy?
- Why did your strategy and your partner's strategy result in the same answer?

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Performance
Tell the students the following story: There were two cartons in the refrigerator with a dozen eggs in each, plus three extra eggs in the holders in the fridge door. Mom liked to eat an omelette each day and used two eggs in each omelette. How many days could she make omelettes before she had to buy more eggs? Ask students to represent the story and solution with the correct mathematical symbols and explain their reasoning. (N7.2)

Performance
An apple tree owner wanted to give away the extra apples that fell from his apple. He offered 3 apples to each child who offered to help collect them. If 50 apples fell to the ground, how many children would get free apples? Will there be any apples left over? Make an array using counters to show your answer**.** (N7.2)

Performance
Ask students to use a model to explain to a classmate how to share 86 marbles among 5 people. (N7.2)

Performance
- Roll two dice to create a 2-digit dividend.
- Arrange the order of the digits so that when divided by 7, will give you the lowest remainder.
- Record the remainder after each play, and total the score after 5 plays.
- Lowest score wins the game.

(example: if you roll a 5 and a 6, decide if the dividend will be "56" or "65".
56 ÷ 7 = 8 R0, and 65 ÷ 7 = 9 R2, so I'll record "0" as my score.
(N7.2)

Performance
A family of 4 has received 60 free text messages each month to share equally. How many texts would each family member receive? Would there be any texts messages left over? Explain your answer. (N7.2)

Performance
Timothy bought a package of 50 dog treats to be shared equally between his 4 Labrador Retrievers, and Joey bought a package of 40 treats to be shared between his 3 Dalmatians. Which dogs received the most treats - the Labrador Retrievers or the Dalmatians? Will there be treats left over? Use square tiles or draw arrays to solve the problem. (N7.2)

Resources/Notes

Chapter Opener
TR p. 8
SB pp 346 - 347

Getting Started
TR pp. 9 - 11
SB 348 - 349

Lesson 1
Exploring Division
N7 (7.2 / 7.3 / 7.4)
TR pp. 12-14
SB p. 350

Additional reading:
Big Ideas from Dr. Small
(Small, 2009) pp. 25 - 41

Teaching Student-Centered Mathematics Grades 3-5, (Van de Walle & Lovin, 2006) pp.121-128

Strand: Number

Specific Outcome

It is expected that students will:
4N7 Continued

4N7.7 Solve a given division problem by relating division to multiplication

Suggestions for Teaching and Learning

Relating division to multiplication was discussed earlier on pages 159 and 161 of the curriculum guide)

Solving division problems by multiplying helps students to get a close estimate of a division answer. Students will also connect multiplication to division by using multiplication to check that their quotient is correct.

Students may need to review related facts of multiplication and division. Proficiency with multiplication and division should not be judged by students' ability to perform one particular algorithm but by their ability to find answers to multiplication and division calculations accurately and efficiently using approaches that are appropriate to specific problems.

Present the following problem to students:
Andre collected $57 in 3 days. If he collected the same amount of money each day, how much was his daily collection?
Have students discuss whether the problem could be represented by the number sentence, 3 x___ = 57. Why or why not?
Students could complete a Four Corner Strategy like the one below to show their understanding of a division problem.
Draw on prior knowledge by reviewing multiplication and division problems involving number facts to 5 × 5 or 25 ÷ 5. Emphasize the connections among the story problems, the models/diagrams, the number sentences and the personal strategies used in calculations.
Have students divide their page into four sections to make graphic organizers and label them as follows:

Four Corner Strategy

Story Problem	Models/Diagrams
Number Sentence	Personal Strategy

Present the students with a problem or a number sentence involving multiplication or division, such as the following:
- You paid 95 cents for 5 apples. What is the cost of each apple?
- 5 × • = 95

Have the students complete the graphic organizer by writing the story problem or the number sentence in one corner and filling in the other corners appropriately.

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Performance

Story Problems

- You travel 84 km in three days. If you travel the same distance each day, how far do you travel each day?
- You have 76 flowers to put into bouquets of 8 flowers each. How many bouquets can you make with these flowers?
- 60 students were going on a bus to the museum. If 3 students could fit on each seat, how many seats are needed for the whole group?

Ask students to solve these problems using multiplication, and write the related multiplication and division sentences. (N7.7)

Performance

Thumbs Up, Thumbs Down, Thumbs Sideways: Present the students with a variety of multiplication and division problems. (Note: Reading the problems orally and also having them displayed on the white board or the overhead projector addresses the different learning styles of the students). For each problem, ask the students to put their thumbs up if multiplication can be used to solve the problem, thumbs down if division can be used, and thumbs sideways if both multiplication and division can be used. Have the students justify their choice, either in small groups or with the entire class.

Finally, have the students write number sentences to support their choices. Emphasize the relationship between multiplication and division as the students suggest different number sentences. (N7.7)

Performance

Write all the possible number sentences that are represented in the following array. Explain how each number sentence relates to the array.

```
********** ********** ********** * *
********** ********** ********** * *
********** ********** ********** * *
```

(N7.7)

Journal

How could you use multiplication to help you solve 65÷8? (N7.7)

Resources/Notes

Lesson 2
Relating Division To Multiplication
N7 (7.3 / 7.7)
TR pp. 15-17
SB p 351

Strand: Number

Specific Outcome	Suggestions for Teaching and Learning
It is expected that students will: **4N7 Continued**	Students need to learn to make sense of the remainder conceptually, as well as how to account for the remainder symbolically, when using a division algorithm. Context is what determines how the reminder should be treated. Exposure to a wide variety of problems using larger numbers with remainders will help support development of number sense.
4N7.2 Solve a given division problem with a remainder, using arrays or base ten materials, and connect this process to the symbolic representation.	In Grade Four, it is not intended that reminders be expressed as decimals or fractions, but as whole numbers in problem solving contexts. Example: Four students wanted to share 46 marbles equally. Students will record the answer as "11 Remainder 2", because each person would get 11 marbles and there would be 2 marbles left over (46÷ 3 =11 R2).
4N7.3 Solve a given division problem, using a personal strategy, and record the process.	Students previously solved problems using personal strategies in unit 6. Refer to previous discussion to now extend to larger numbers. Students have had many experiences using number lines and most many will be proficient in using it as a tool for division. They may begin to use repeated subtraction on a number line in this lesson to help them with larger dividends. Students will soon realize that choosing greater numbers to subtract will help them solve the problem more quickly. Encourage students to explain their reasoning for choosing the size of groups to subtract. It is important that students record their steps as they work through the processes in this strategy.
4N7.5 Create and solve a division problem involving a 1- 0r 2- digit dividend, and record the process.	This was discuss in earlier unit (refer to Curriculum Guide p.155). It is important to restate that students should have many opportunities to solve and create word problems for the purpose of answering real-life questions of personal interest. These opportunities provide students with a chance to practice their computational skills and clarify their mathematical thinking. Examples: •solving a problem: 63 people lined up to ride the roller coaster, The Bat, at Canada's Wonderland. Each car holds 4 people. How many cars were needed for the line up? (16 will be needed because 15x 4 = 60, which would give you 15 full cars, but another car will be needed for the remaining 3 people) •creating a problem: Ask students to make up division problems about situations in the classroom. Have the problems posted and invite the class to circulate around the classroom solving their classmate's problems.

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Performance

An excellent game for students to practice solving problems with remainders can be found at:
http://www.mathsolutions.com/documents/0-941355-42-X_L3.pdf
(N7.2 / N7.3)

Student – Teacher Dialogue
(Insert name of your school) has collected 85 "VOCM Coats for Kids" and is packaging 5 coats in each bag. How many bags will be needed?
Draw number line showing division involving repeated subtraction. Ask students to justify the size of group they chose to subtract, in order to solve the problem. If smaller groups were chosen, ask them if the problem could have been solved using larger groups, and therefore fewer steps. (N7.3)

Journal
Create a problem that can be represented by the number sentence:

$$64 \div 4 = \_\_\_$$

Use a number line and repeated subtraction to show your workings.
(N7.5 / N7.3/ PR 6.4)

Pencil-Paper
Melanie has 95 dollars in nickels. How many nickels does she have? Use repeated subtraction to help you solve the division problem.
(N7.3)

Resources/Notes

Lesson 3
Using Subtraction to Divide
N7 (7.2 / 7.3 / 7.5)
P6 (6.4)
TR p. 18-21
SB pp. 352-355

Strand: Number

Specific Outcome *It is expected that students will:*	Suggestions for Teaching and Learning
4PR6 Solve one-step equations involving a symbol to represent an unknown number. [C, CN, PS, R, V]	
4PR6.4 Solve a given equation when the unknown is on the left or right side of the equation.	This indicator was discussed in unit 6 for smaller numbers. Again, incorporate opportunities for students to encounter equations with the missing number being in different places.
4N7 Continued	
4N7.1 Solve a given division problem without a remainder, using arrays or base ten materials, and connect this process to the symbolic representation.	See CG page 155
4N7.3 Solve a given division problem, using a personal strategy, and record the process.	Another personal strategy that students may choose when dividing using larger dividends is "renaming" the dividend by splitting it into comfortable parts. Students should be encouraged to choose numbers that relate to multiplication and division facts they already know when renaming numbers to solve a division problem. The usefulness of this strategy depends on the students' number sense, and may require a lot of practice in renaming numbers that are easily divided by various 1-digit divisors. Modeling using base ten blocks will be an important tool in implementing this personal strategy. Play money can be a substitute for base ten materials for students who have grasped place value money concepts. Example: 93 ÷ 5 can be renamed as 45 + 45 + 3, because I know that 45 is divisible by 5. 45 ÷ 5 + 45 ÷ 5 +3 = 9 + 9 R3 = 18 R3

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Resources/Notes

Lesson 3 Continued

Lesson 4
Dividing by Renaming
N7 (7.1 / 7.2 / 7.3)
N6 (6.4 / 6.6)
TR p. 22 - 24
SB pp. 356 - 357

Pencil/Paper
Show 2 strategies that could be used to calculate 48÷4. **(N7.3 / N7.1)**

Journal
How can you use 82= 40+40+2 to calculate 82÷4? **(N7.3 / N7.1)**

Performance
Highest Quotient Game: (a pair activity)
- Randomly select 3 division fact cards each from a given pile.
- Keep only 2 of the cards, and return one to a discard pile.
- Calculate the quotient on each fact card
- Add quotients together
- Player with the highest total receives a point.
- Play until one player receives 10 points.
- Ask students to choose one play, and share strategies used in how they decided which card to place back in the discard pile.

More practice may be required.

Strand: Number

Specific Outcome

It is expected that students will:

4PR6 Continued

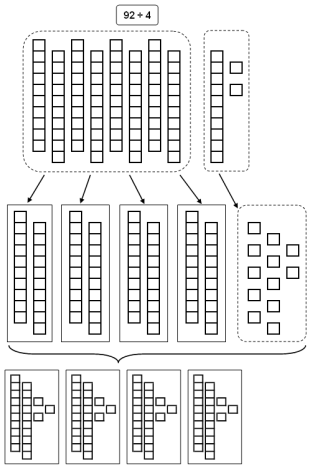
4PR6.6 Represent and solve a given multiplication or division problem involving equal grouping or partitioning (equal sharing), using a symbol to represent the unknown.

Suggestions for Teaching and Learning

There are two concepts of division (discussed on page 155 of CG). Both are described by Van de Walle and Lovin (2006):

1) Fair sharing:

A bag has 92 jelly beans, and Aidan and her three friends want to share them equally. How many jelly beans will the three girls get?



A rod is traded for 10 units when there are no more rods to pass out. Then the 12 units are distributed, resulting in 23 in each set.

Using base ten pieces makes the fair sharing easier to solve. This is digit oriented, as opposed to an approach that helps students think of the whole value of the dividend and is the idea on which the traditional algorithm is built - share the hundreds first, then the tens, then the ones. Present this type of problem as well as the following type, for students to try:

2) Here is the measurement or repeated subtraction concept(discussed on previous page):

Jumbo the elephant loves peanuts. His trainer has 625 peanuts. If he gives Jumbo 20 peanuts a day, how many days will the peanuts last?

This time students need to find out how many 20's there are in 625. Initially, they might guess:
- Try 20 (peanuts) x 10 (days)→ 200 (not nearly enough)
- Try 20 (peanuts) x 30 (days)→ 600 (now there are 25 peanuts left)
- Use 20 more peanuts for 1 more day. That makes 620 peanuts used with just 5 peanuts left over – not enough for another full day.

The peanuts will last 31 days!

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Resources/Notes

Lesson 4 (cont'd)

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Strand: Number

Specific Outcome

It is expected that students will:
4N7 Continued

4N7.6 Estimate a quotient, using a personal strategy; e.g., 86 ÷ 4 is close to 80 ÷ 4 or close to 80 ÷ 5.

Suggestions for Teaching and Learning

Students make estimates that allow them to judge the reasonableness of their answers. When working on problem situations, students should know when it's necessary to be accurate, and when an estimate is suffice.
Remind students when estimating, to use facts that are close to dividends given. This will make for closer, and more reasonable estimate. Proficiency in recall of multiplication facts, and the use of use predicting skills, will help students provide a reasonable estimate for a division problem.

It is important to remember that computational estimation is generally a mental activity; therefore, regular oral practice, accompanied by the sharing of strategies, must be provided and ongoing throughout the year. The goal is for students to become so competent with the skill that they automatically estimate in any problem situation, not only when asked to do so by the text or the teacher.

One of the best ways of working on estimation skills seems to be to integrate them with other areas of the mathematics curriculum. (Elementary School Mathematics, p.203)

As students explore estimating divisors and dividend they will observe that they have different effects on the problem's outcome. Rounding the dividend up increases the estimated quotient, but rounding the divisor up decreases the estimated quotient (Small, 2009, p.34)

To estimate quotients, students might use the following strategies:

Estimation Strategy	Example
Round numbers such that familiar multiplication and division facts can be used.	574 ÷ 9 is about 560 ÷ 8 = 70 574 ÷ 9 is about 540 ÷ 9 = 60
When dividing round both numbers up or both numbers down.	337 ÷ 8 is about 360 ÷ 9 = 40 337 ÷ 8 is about 280 ÷ 7 = 40
Round numbers to the nearest multiple of 10 when the divisor in the problem divides evenly into a multiple of 10…or 25 to be able to divide by 25.	389 ÷ 27 is about 400 ÷ 25 =16 612 ÷ 27 is about 600 ÷ 25 = 24

(Small, 2009, p.34)

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Performance

Provide a list of division questions to pairs of students and ask them to do the following:

(1) estimate a quotient
(2) explain their strategy to their partner
(3) tell whether or not the estimate is too high or too low, and why.

(N7.6)

Performance

- Jason rode his bicycle every day for 8 days. He cycles 68 km in total. About how far did he ride each day?

- Ninety-eight parents were expected to attend the school's "Volunteer Appreciation" luncheon. About how many packs of 8 muffins should be purchased to ensure there are enough to serve all of the guests?

(N7.6)

Journal

- Explain how you know that $89 \div 9$ is about 1 more than $79 \div 9$.

- Describe a situation in which you might want to estimate $67 \div 7$.

(N7.6)

Resources/Notes

Lesson 5
Estimating Quotients
N7 (7.3 / 7.6)
N6 (6.4 / 6.6)
TR pp 29-32
SB p. 360-363

Math Game
3 Card Quotient
N7
TR p. 33
SB p363

Strand: Number

Specific Outcome

It is expected that students will:
4N7 Continued

4N7.3 Solve a given division problem, using a personal strategy, and record the process.

Suggestions for Teaching and Learning

Students have solved problems with personal strategies before but now the focus is on traditional algorithms using base ten blocks. The focus in solving division problems using larger numbers should be on invented strategies and not just the traditional algorithm, as it cannot be taught with a strong conceptual basis. Far too many students learn them as meaningless procedures, develop error patterns, and require an excessive amount of reteaching or remediation. No matter what the division algorithms is, either traditional or otherwise, it is important that students show they understand by being able to explain what they are doing and why.

It is appropriate to initially model the algorithm with manipulatives. Using base ten blocks when choosing to solve division problems using traditional algorithms will help conceptualize students' understanding of division being "equal groups". Students will have had many experiences in regrouping using base ten blocks in Chapter Two. Whatever strategy students choose to solve division problems, the emphasis should be on the connections between the concrete representation and the symbolic personal strategies.

Have the students apply their personal strategy to solve a variety of division problems that include equal sharing and equal grouping with and without remainders. Note that the traditional division algorithm is built on the process involved with fair-share problems (Van de Walle 2001).

Encourage students to use correct mathematical language, such as the following, when describing algorithms:

- regroup
- trade or exchange
- place value terms such as hundreds, tens and ones
- product
- quotient
- remainder

Discourage incorrect mathematical language such as "9 doesn't go into 8" for a division problem such as 87÷9. It is 87, not 8 that you are dividing by 9.

Students should be encouraged to discuss whether or not an answer is reasonable by seeing if it is close to an estimate made prior to completing the problem, and then checking the answer by multiplying and adding the remainder

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Performance

Present the following problems to the students:
Andre collected $57 in 3 days. If he collected the same amount of money each day, how much was his daily collection?
Guide discussion as to whether the numbers in the problem and the unknown refer to - the whole? the number of groups? or the quantity in each group? Discuss which operation would be used to solve the problem, and what would be a good estimate for the answer.
Encourage the students to represent the problem using base ten materials and to record the process.

The school custodian needs to place an order for fluorescent light bulbs for his school. If they come in packages of 6, how many packages will he need to buy if he needs 89 lights? Will he have any light bulbs left over to go towards his next order? If so, how many? Use base ten blocks to help you solve the problem. (N7.2)

You have 98 beads to make 4 necklaces. If each necklace has the same number of beads, how many beads are on each necklace? Will any beads be left over? If so, how many? Represent the problem using base ten blocks.
(N7.2)

Provide a set of base ten blocks. Ask the students to model 3 different division questions of his/her choice and write the division sentence for each. (N7.1 / N7.2)

Present the following problem to the student and have him or her read it orally. Have base ten materials available to use as needed.
A bottle contains 76 mL of medicine. Jerry takes 8 mL of medicine each hour. How many hours will pass before all the medicine is gone?
Pose the following questions to guide thinking if necessary:

- State the problem in your own words.
- What do each of the numbers in the problem represent—whole, the number of groups or the quantity in each group?
- What is the unknown in the problem—whole, the number of groups or the quantity in each group?
- What number sentence could you write to show the meaning of the problem?
- Does the problem use multiplication or division or both? Explain.
- About how many hours will pass before the medicine is all gone? Explain your thinking.
- Will any medicine be left over? Explain.
- Use a strategy that makes sense to you to find the answer to the problem. Explain your thinking as you write the numbers.
- Explain how you know your answer makes sense and is reasonable.
- Would you solve the problem another way? Explain your thinking.

Resources/Notes

Lesson 6
Dividing by Sharing
N7 (7.1 / 7.2 / 7.3/ 7.6)
N6 (6.4 / 6.6)
TR pp. 34-36
SB pp364-366

This lesson shows an algorithm which is very close to the 'traditional algorithm'. Consider extending this to the traditional algorithm since the traditional algorithm for division is typically familiar to parents and allows them to be of help to their children at home.

Curious Math (optional)
Remainder Magic

TR p. 37
SB p. 367

Strand: Number

Specific Outcome

It is expected that students will:

4N7 Continued

4N7.5 Create and solve a division problem involving a 1- or2- digit dividend, and record the process.

Suggestions for Teaching and Learning

In a "Guess and Test" strategy, a student guesses an answer to a problem, then tests it to see if the "guess" works. If it doesn't, the student revises the "guess" **based on what was learned** and tries again. This repetitive process continues until the answer is found. Some students are able to think through several guesses at once; others need to go one step at a time. Although we often talk about guessing as bad, this strategy reinforces the value of taking risks and learning from the information that is garnered. (Small , 2005)

Students should be encouraged to use diagrams, counters, multiplication tables, arrays, and base ten blocks to help them work through possible answers. Organized lists also help students to keep track of guesses so they are not repeated.

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Performance
All Grade four classes collected the same number of recyclables for the school's Recycling Blitz. Together, they collected 90 recyclables. How many Grade Four classes could there be in the school? Give 3 possible solutions for your problem. (N7.3)

Performance
Create a problem that you could solve by guessing and testing. Solve your problem. (N7.3 / N7.5)

Performance
The same digit is missing from each box. What is the digit?

4___ ÷ 8 = 5 R ____

(N7.3)

Performance
What 2 numbers have a product of 20, and a quotient of 5? (answer: 10 and 2) (N7.3)

Performance
Christopher had between 60 and 70 hockey cards in his collection. He can package them equally in either groups of 2, 4 or 8. How many cards does he have? Use the Guessing and Testing strategy to help solve your problem. Explain your solution.
(answer: 64 hockey cards. 64 is 30 groups of 2, 16 groups of 4, and 8 groups of 8). (N7.3)

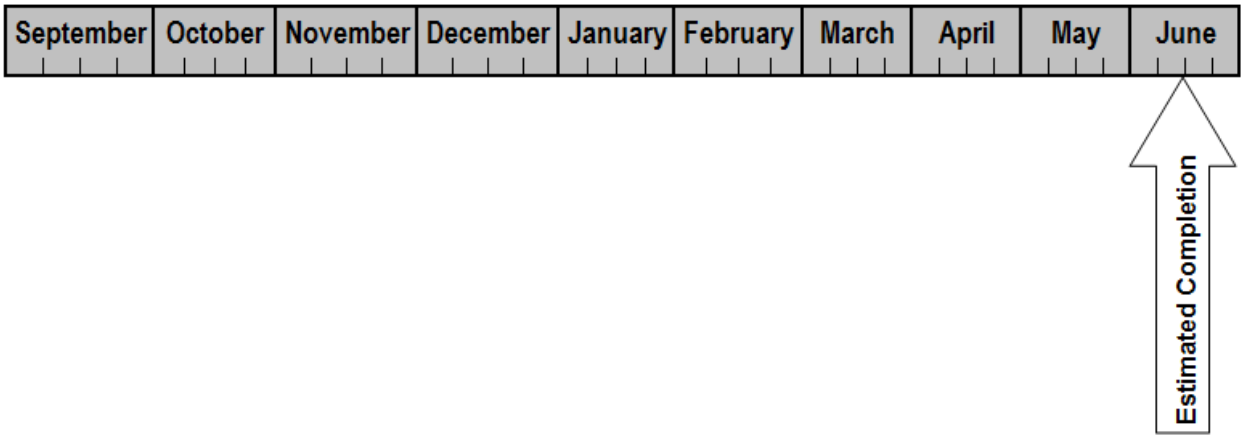
Resources/Notes

Lesson 7
Solving Problems by Guessing and Testing
N7 (7.3 / 7.5 / 7.6)
TR p. 38-39
SB pp. 368-370

Math Game
Remainder Hunt
N7
TR p. 41
SB p. 371

Chapter Task (Optional)
TR pp.47-48
SB p. 375

Unit 11
3-D GEOMETRY
Suggested Time: approx. 1 ½ weeks



Unit Overview

Big Idea

'Geometry enables us to describe, analyze and understand our physical world so there is little wonder that it holds a central place in mathematics or that it should be a focus throughout the school mathematics curriculum' (Navigating through geometry)

As students move through school, they should receive instruction that links to, and builds on the foundation of earlier years. They must be continually challenged to apply increasingly more sophisticated spatial thinking to solve problems in all areas of mathematics as well as in all other school home and other life situations. (Navigating through Geometry 3-5, p.8)

As students develop mathematically and become more familiar with geometric attributes, they are increasingly able to identify and name a shaped by examining its properties and using reasoning. Through exploration of three dimensional shapes, students develop awareness that there are certain specific attributes that they can use to classify the shapes. They will also be encouraged to develop and communicate mathematical arguments about geometric relationships

Spatial sense can be described as an intuition about shapes and the relationship among shapes. This includes the ability to be able to visualize shapes and to be able to turn them around their minds. Many people say that children *are born with* a spatial sense or not. Van de Walle & Lovin (2006) says "this is simply not true! We know that rich experiences with shape and spatial relationships, when provided consistently over time, can and do develop spatial sense.

Process Standards Key

[C] Communication	[PS] Problem Solving
[CN] Connections	[R] Reasoning
[ME] Mental Mathematics and Estimation	[T] Technology
	[V] Visualization

Strand: Shape and Space (3-D Objects and 2-D Shapes)

Specific Outcome

It is expected that students will:

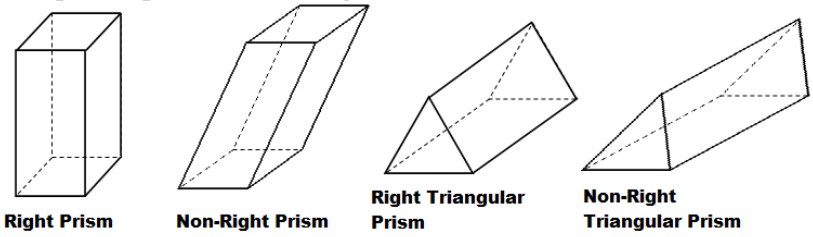
4SS4 Describe and construct right rectangular and right triangular prisms.
[**C**, CN, R, **V**]

Suggestions for Teaching and Learning

Students will draw upon their previous knowledge of two dimensional polygons to assist them in their identification and description of prisms. In the earlier grades children will have classified geometric shapes by general characteristics and will now develop more detailed ways to describe objects. They will identify properties of shapes and learn to use proper mathematical vocabulary to describe the shapes.

A good way to explore shapes is to use smaller shapes or tiles to create larger shapes. Different criteria or directions can provide the intended focus to the activity. Pattern blocks are very good for this, but many teacher-made materials can be used. While the pattern block pieces are prisms, they have been treated as 2-D shapes; however, stacking a number of triangles or squares would provide examples of different prisms. This stacking would help students conceptualize the uniform nature of prisms. Also, students can make skeletal models for prisms, using rolled newspapers and tape, straws and string, or toothpicks and miniature marshmallows. Commercial sets of 3-D objects usually have a variety of prisms.

Note: All prisms used in Grade 4 are 'right' prisms. For clarification purposes, a prism is 'right' if the faces form a right angle with the bases (or we can say 'are perpendicular with the bases'). Below are examples of prisms illustrating the difference:



Although the outcome and indicators use the terminology 'right' for purposes of distinguishing between right prisms and other prisms it is not necessary for students to use the term 'right' in their descriptions. At this level, 'rectangular prism' and 'triangular prism' is sufficient for students.

All prisms have **faces**, two of which are customarily referred to as **bases**. These two bases may take the shape of any polygon. For clarification purposes, prisms can be thought of as having two names. The first name refers to the shape of the bases and a second name, which is **prism.** Examples: triangular prism, rectangular prism. Some students may be keen to identify other prisms such as hexagonal prisms or square prisms (square prisms fall into the category of rectangular prisms because a square is a rectangle). In Grade Four, exploration is focused on **rectangular prisms** and **triangular prisms** only.

General Outcome: Describe the Characteristics of 3-D Objects and 2-D Shapes, and Analyze the Relationships among them

Suggested Assessment Strategies

Performance
After a thorough treatment of prisms, give students a blank Frayer Model graphic organizer to communicate their understanding of prisms.

Resources/Notes

Chapter Opener

Getting Started

Strand: Shape and Space (3-D Objects and 2-D Shapes)

Specific Outcome

It is expected that students will:

4SS4 Continued

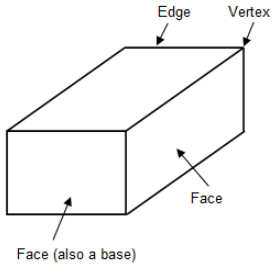
Achievement Indicators:

4SS4.1 Identify and name common attributes of right rectangular prisms from given sets of right rectangular prisms.

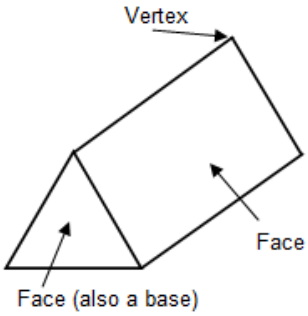
4SS4.2 Identify and name common attributes of right triangular prisms from given sets of right triangular prisms.

Suggestions for Teaching and Learning

There is a developmental sequence associated with how students think and reason geometrically. Many students in Grade 4 are beginning to develop more sophisticated abilities to identify and name 3-D objects. As levels of geometric thinking develop, students will notice more attributes of three dimensional objects. These attributes are the components that go together to make up the form – **edges, vertices** and **faces, (**two which are the **bases)**. In the process of identifying and naming attributes of prisms, it may necessary to review and encourage students to use appropriate vocabulary such as number of faces, number of edges, number of vertices or shapes of the faces/bases.



A rectangular prism has 6 faces, 12 edges and 8 vertices.
(Note that all square prisms can be called rectangular prisms because a square is a rectangle)



A triangular prism has 5 faces, 9 edges and 6 vertices.
Allow each student to manipulate concrete models of 3-D shapes so that they are able to touch and count each of the faces, vertices and edges.

One way to familiarize students with right rectangular prisms is have several shapes in front of pairs of students for them to examine as you call out clues about the properties of the shape. For example, “This 3D shapes has 8 vertices.” As you give clues, have the children figure out which shape you are thinking of. While some students may be able to think of the shapes visually, it is best to give all student (or pairs of students) the concrete objects to help them.

General Outcome: Describe the Characteristics of 3-D Objects and 2-D Shapes, and Analyze the Relationships among them

Suggested Assessment Strategies

Resources/Notes

Lesson 1
Recognizing Rectangular Prisms

TR pp. 11-13
SB pp. 380

Lesson 2
Recognizing Triangular Prisms

TR pp. 16 - 19
SB pp. 382 - 384

Lessons 1 and 2 may be combined or treated separately, depending on teacher preference.

Strand: Shape and Space (3-D Objects and 2-D Shapes)

Specific Outcome

It is expected that students will:

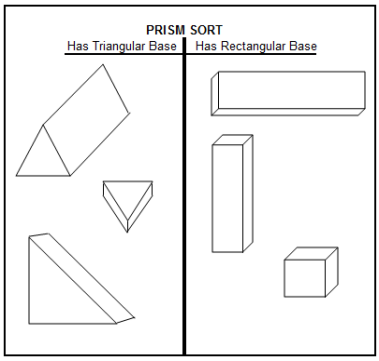
4SS4 Continued

4SS4.3 Sort a given set of right rectangular and right triangular prisms, using the shape of the base.

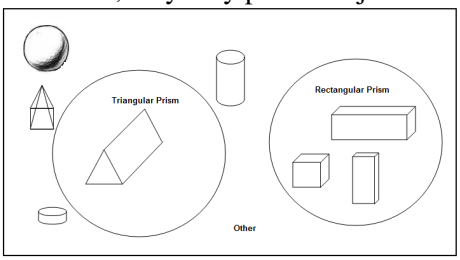
4SS4.7 Identify examples of rectangular and triangular prisms found in the environment.

Suggestions for Teaching and Learning

Sorting requires students to attend to specific attributes of objects. Give students a variety of 3D prisms (real life or commercially made models). Have them sort the prisms according to the attribute: Shape of the Base. Make a class T-chart as shown below:



Provide 3-D objects (real life or commercially made models) such as spheres, cones, cylinders, pyramids (students will be familiar with these from Grade 3) as well as rectangular prisms and triangular prisms. Place two hula hoops on the floor to represent a large scale Venn diagram such as the one shown below. Provide labels and have students sort the objects according to triangular prisms/ rectangular prisms/ other. As students place their object on the diagram, have them explain, to the class, why they placed objects in certain places.



Shape Hunt – Display a set of right rectangular prisms on a table (vary the set by including: different sizes of triangular and rectangular prisms; cubes; and prisms positioned in different orientations). Have students go around the room or the school and find objects that match the shapes. Ask individual students to present their findings. Ask how their 'found' object is alike or different from prisms on the display table. Listen to student responses and encourage them to name the common attributes.

Consider:
- What might prisms be used for? *[Sample responses: to hold things/to support roofs/to contain things inside]*
- Why might prisms have different sizes and shapes? *[Sample responses: the contents might determine the best shape for a container/some prisms might need to be larger to provide strength or support, such as a table leg/decorative reasons]*

General Outcome: Describe the Characteristics of 3-D Objects and 2-D Shapes, and Analyze the Relationships among them

Suggested Assessment Strategies

Journal
Give students two different drawings of prisms. Have them find the model to match from a set in the classroom. Glue the pictures in their journal and answer the question, "How are these prisms different?" (Students may refer to Math Word Wall to write their descriptions)

Presentation
Riddles - Encourage students to use the attributes of any prism (number of faces, number of edges, number of vertices, or shapes of the faces) to describe prisms . E.g. I have . . .

Performance
Have students name the prism that best represents various real-life examples of 3-D objects.

Performance
Have student work together to sort their collection of 3-D objects into two groups: rectangular and triangular prisms. Ask: what are the attributes of the shapes that made them alike? How are they different? What makes a rectangular prism a cube? What kind of prism would you have if you built from a rectangular base?

Resources/Notes

Lesson 3
Communication About prisms
TR pp.21-25
SR pp.386-388

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Strand: Shape and Space (3-D Objects and 2-D Shapes)

Specific Outcome

It is expected that students will:

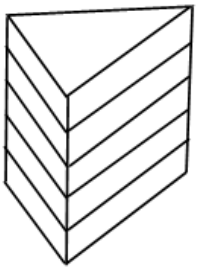
4SS4 Continued

4SS4.4 Construct and describe a model of a right rectangular and a right triangular prism, using materials such as pattern blocks or modeling clay.

4SS4.7 Identify examples of right rectangular and right triangular prisms found in the environment.

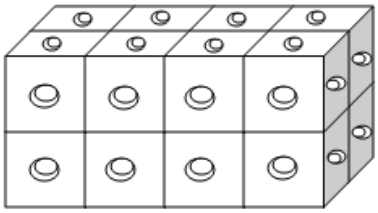
Suggestions for Teaching and Learning

Constructing prisms can take many forms. One way to represent shapes is to make concrete models. Have students stack pattern blocks to build a prism such as the following:

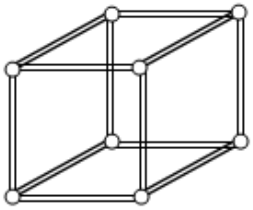


Build prisms with other pattern block shapes. Ask which prism can they build from pattern blocks that has the most faces (hexagon-based prism)

Have students build rectangle based prisms with interlocking cubes:



Another type of representation is a skeleton. This is a model showing only the edges and vertices of a 3-D shape. Have a variety of 3-D shapes available to students. Some may need to touch the edges and vertices in order to construct a skeleton. The process of making a skeleton helps students be able to visualize the shape and remember its properties. Have students build skeletons of prisms using materials such as toothpicks and small balls of modeling clay or straws with pieces of pipe cleaners. E.g.



General Outcome: Describe the Characteristics of 3-D Objects and 2-D Shapes, and Analyze the Relationships among them

Suggested Assessment Strategies

Stack pattern blocks to make rectangular prisms and triangular prisms. Describe how they are alike and how they are different.

Ask students to build skeletal models of two different triangular pyramids. Ask them how they are the same/different?

Listen as students construct nets on geoboards and using grid/isometric paper; are they discussing the attributes of the object, are they using the correct vocabulary (faces, edges, vertices, congruency)?

Resources/Notes

Lesson 4
Constructing Prisms

TR pp.26-28
SB p. 389

Curious Math

TR pp. 14-15
SB pp. 381

This activity can be used with Lesson 1 or Lesson 3

Additional reading:
Big Ideas from Dr. Small,
(Small 2009) pp.106 - 108

Strand: Shape and Space (3-D Objects and 2-D Shapes)

Specific Outcome

It is expected that students will:

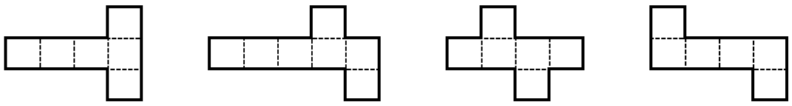
4SS4 Continued

4SS4.6 Construct right triangular prisms from their nets.

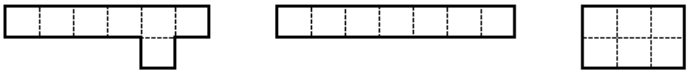
4SS4.5 Construct right rectangular prisms from their nets.

Suggestions for Teaching and Learning

Students should be given copies of **nets** of **rectangular** and **triangular** prisms to cut out and fold up. They should be encouraged to unfold them and examine the 2-D shapes that are connected to make each net. Have them visualize the folding up and unfolding. In addition to cutting out and assembling prepared nets, it is now expected that students will draw their own nets for rectangular and triangular prisms. They will also consider the various possibilities for these nets. Have the students trace on paper the various **faces** of the different prism to make its net. Have the students cut out the net and fold it up around the shape to see if it works. Ask them to record this net on grid paper. Have them cut one of the faces off and investigate the possible places it could be reattached to make a new net. Have them record each one on grid paper.



Possible nets for a cube



Not nets for a cube

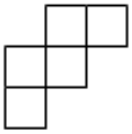
General Outcome: Describe the Characteristics of 3-D Objects and 2-D Shapes, and Analyze the Relationships among them

Suggested Assessment Strategies

Performance
Provide students with various nets of prisms for them to construct. Have them label each face of their model using the words "face" and "base" as well as identify their 3-D object.

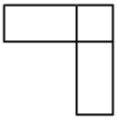
Performance
Have the students trace on paper the various faces of the different prisms to make its net. Have the students cut out the net and fold it up around the shape to see if it works. Ask them to record this net on grid paper. Have them cut off one of the faces and investigate the possible places it could be reattached to make a new net. Have them record each one on grid paper.

Performance
Provide the students with a pentomino puzzle piece (a 2-D shape made by joining 5 squares along full sides) that would fold to make a box with no top.



Ask them to trace this piece and then add a square for the top of the box. Ask: In how many places can this square be added? (Note: Students may wish to cut this from grid paper.)

Performance
Tell the students that this diagram is part of a net for a square prism. Ask them to complete the net by drawing the additional faces that would be needed.



Performance
Give small groups of students a set of 4 or 5 nets of rectangular or triangular prisms. Each set should consist of one net that can be made into the 3-D object, and 3 or 4 others which cannot be made into the 3-D object. Have the student analyse the nets, without manipulating them, to determine which one of the nets in the group could be used to create the 3-D object. Have them justify, and then test their predictions.

Resources/Notes

Lesson 5
Constructing Prisms from Nets

TR pp.29-31
SB p. 390

Chapter Review
Chapter Task

Use selectively